MODEL AIRPLANE NEWS

DRAG-REDUCTION TIPS!

THE WORLD'S PREMIER R/C MODELING MAGAZINE

48120 May 1996

LAND LIKE A PRO
10 ILLUSTRATED TECHNIQUES

MODEL TECH
ARC P-51

How To
- Build scale control surfaces
- Install wing-mounted servos
- Set up giant-scale control systems

Pitts
A SPECIAL HISTORY

QSAA FLY-IN
200+ GIANTS

Ziroli's HEINKEL Electric Jet— *We have the plans!*
—Page 1

WE REVIEW
- NEW FUTABA 8-CHANNEL RADIO
- THUNDER TIGER'S TIGER STICK
- HOBBY LOBBY ELECTRIC FLAME
- MVVS .40 ENGINE • ACE R/C DIGIPACE 3

USA $3.95 CANADA $4.95
05>
0 71896 48120 4

MODEL AIRPLANE NEWS

MAY 1996 • VOLUME 124, NUMBER 5

features

construction

columns

departments

reviews

ON THE COVER: *(main photo) the Model Tech ARC P-51 Mustang begins a high-speed pass for the camera (photo by Rich Uravitch). Inset—Dean Lassek poses with his impressive A-10 Warthog at the Las Vegas QSAA Giant-Scale Fly-In (photo by Bob Banka). Bottom inset: the Pitts Special biplane—the icon of aerobatic aviation—is highlighted in this issue (photo by Budd Davisson).*

ON THIS PAGE: *the latest incarnation of the classic "Stik" model, the Thunder Tiger "Tiger Stick" is a great ARF for pilots who want to get into the air fast (photo by Walter Sidas).*

MODEL AIRPLANE NEWS

■
EDITORIAL
Group Editor-in-Chief TOM ATWOOD
Editor GERRY YARRISH
Senior Editor CHRIS CHIANELLI
Associate Editor ROGER POST JR.
Assistant Editor DEBRA D. SHARP

■
COPY
Copy Director LYNNE SEWELL
Senior Copy Editor KATHERINE TOLLIVER
Copy Editor ANNETTE PARKER MARTIN
Assistant Copy Editor KATHLEEN J. DOHERTY

■
ART / DESIGN
Managing Art Director ALAN J. PALERMO
Associate Art Director BETTY K. NERO
Assistant Art Director ANGELA A. CARPENTER
Graphic Artist MICHAEL BOUSE
Assistant Art Director LESLIE COSTA
Staff Photographer WALTER SIDAS
Image Technician CHRISTOPHER HOFFMASTER

■
CONTRIBUTING EDITORS
Dave Baron, Joe Beshar, Mike Billinton, Mike Cherry, Roy L. Clough Jr., Hal deBolt, Bob Fiorenze, Dave Gierke, Bill Griggs, Henry Haffke, Tom Hunt, Sal Iasilli, John E. Jundt, Michael Lachowski, Andy Lennon, George Leu, Jim Newman, Vic Olivett, Jim Onorato, Dan Parsons, Dave Patrick, Dave Platt, Mitch Poling, Frank Ponteri, Randy Randolph, Jef Raskin, Guy Revel, Carl Risteen, Jim Sandquist, Stephen Scotto, Dave Shadel, Keith Shaw, Jim Simpson, Faye Stilley, Bob Underwood, Roy Vaillancourt, George Wilson, Dave Windom, Rob Wood, Nick Ziroli.

■
PUBLISHING
Group Publisher LOUIS V. DeFRANCESCO JR.
Publisher YVONNE M. DeFRANCESCO
Associate Publishers GARY DOLZALL
SHARON WARNER

■
ADVERTISING
Director of Advertising SHARON WARNER
Advertising Account Executives
JILL ELLEN MOLINARO, JENNIFER IZZO
HILARY BURKE REICHHELM
Advertising Traffic Administrator
ELISE SILKOWSKI
Advertising Coordinator ANN T. WIEBER

■
MARKETING
Director of Marketing GARY DOLZALL
Marketing Manager DANIELLE RUGGIERO

■
CIRCULATION
Circulation Manager ARLENE A. DELGIUDICE
Circulation/Marketing Coordinator
JENNIFER KELSEY

■
PRODUCTION
Production Manager MARY REID McELWEE
Production Assistant ARLENE MELKO

■
SYSTEMS
Systems Manager GORDON OPPENHEIMER

■
CORPORATE
Chairman DR. LOUIS V. DeFRANCESCO
President and CEO MICHAEL F. DOYLE
Vice President G.E. DeFRANCESCO
Secretary L.V. DeFRANCESCO
Treasurer YVONNE M. DeFRANCESCO

INTERNET *man@airage.com*

MODEL AIRPLANE NEWS (ISSN 0026-7295, USPS 533-470) is published monthly by Air Age Inc., 251 Danbury Rd., Wilton, CT 06897-3035. Second-class-postage permit paid at Wilton, CT, and additional mailing offices.

SUBSCRIPTION INFORMATION: call (800) 827-0323. U.S.: $34.95 for one year, $55.95 for two years. Canada: $51.31 for one year, $87.69 for two years (Canadian prices include G.S.T.). Elsewhere: $47.95 for one year, $81.95 for two years. Canadian G.S.T. registration no. 13075 4872 RT.

EDITORIAL: send correspondence to Editorial Dept., *Model Airplane News,* 251 Danbury Rd., Wilton, CT 06897-3035. We welcome all editorial submissions, but assume no responsibility for the loss of or damage of unsolicited material. To authors, photographers and people featured in this magazine: all materials published in *Model Airplane News* become the exclusive property of Air Age Inc., unless prior arrangement is made in writing with the Publisher.

ADVERTISING: send advertising materials to Advertising Dept., *Model Airplane News,* 251 Danbury Rd., Wilton CT 06897-3035. Phone (203) 834-2900; fax (203) 762-9803.

CHANGE OF ADDRESS: to make sure you don't miss any issues, send your new address to *Model Airplane News,* P.O. Box 428, Mount Morris, IL 61054-9853, six weeks before you move. Please include the address label from a recent issue, or print the information exactly as shown on the label. The Post Office will not forward copies unless you provide extra postage.

POSTMASTER: please send Form 3579 to *Model Airplane News,* P.O. Box 428, Mount Morris, IL 61054-9853.

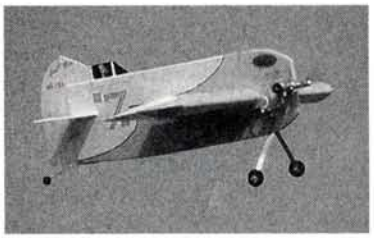
AirAge PUBLISHING

Member Audit Bureau of Circulations

PRINTED IN THE USA

AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897-3035; e-mail: man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we can not respond to every one.



The Morris Hobbies Gee-Whiz-Bee, which was reviewed in the December issue of Model Airplane News.

PROFILE FUN

Several years ago, I subscribed to *Model Airplane News*. I now consider your publication my R/C bible!

You recently published some information about the new and very exciting airplanes that have been developed by Morris Hobbies. Although I have been active in R/C flying for over 15 years, I had never heard of anything that flew like these airplanes. I have looked into Morris Hobbies and am most impressed with the quality of their people and products.

The value to your readers of your featuring new developments is great. I had taken a year off from my R/C airplanes to learn to fly real airplanes. After a busy year that included earning a private pilot's license and an instrument rating, purchasing two Cessna 172s and landing at 43 different airports in 13 states, I was ready to get back into flying my 1/4-scale models. I enjoy them, but was ready for a change, which I found when I read your information about Morris Hobbies.

Thanks for doing such a good job with your magazine. It is full of a wide variety of quality information. You play a major role in keeping this hobby interesting and challenging. I look forward to reading *Model Airplane News* for many years to come.

DAVID J. HUMPHREYS
President, Recreation Vehicle Industry Association
Reston, VA

We appreciate your feedback, David. The Morris Hobbies profile models are great for aerobatics and fun-flys. Stay tuned for more innovative R/C developments. DS

MCA FOLLOW-UP

I would like to comment on Roger Post's "Minimum Controllable Airspeed" article in the January '96 issue of *Model Airplane News*. It so happened that I read this the night before the maiden flight of my scratch-built Energizer Dick Sarpolus design with Zenoah G-23 power.

After some taxi tests, I followed your advice and started the takeoff roll with about 30-percent power. The takeoff roll was slightly longer—about 75 to 80 feet—and it was so easy to control a straight line with rudder. When the tail came up and flying speed was reached, I applied a gentle back pressure, and my pride and joy was airborne. A gentle turn and climb to altitude for trimming and then the higher-powered flight, just as you described. This had to be the most relaxed and easiest flight ever. Since then, I have changed my takeoff technique for all my airplanes and enjoy more relaxed and better-looking takeoffs than ever before. I've been flying now for slightly more than two years. Articles like yours really help.

RON CARL
Rancho P.V., CA

Ron, I'm glad everything went smoothly. There are two things that I would like to add to this discussion. The list of determining factors (listed on page 26 of the January issue) should include wing loading, and for those who are leery about this technique, keep in mind that most R/C planes are quite overpowered for their weight. So, taking off at a throttle setting other than full is possible. RP

POWERPLANT FOR AEROBATICS

I'm a 16-year-old airplane enthusiast from Mexico City. A year ago, I purchased a Byron Sukhoi, and I'm looking for an engine for it. Because it's a 1.20-size airplane, I was thinking of the O.S. twin, but a friend told me that 4-stroke engines are too slow for that kind of aerobatic plane. Can you help?

ADOLFO NIETO
Mexico City, Mexico

Adolfo, I called Mark Jensen at Byron Originals, and he told me that your O.S. 1.20 twin is an excellent engine for the Sukhoi; it will provide all the performance you'll need. Happy flying! DS

POLISH PEN PAL

My name is Marian Nazimek. I'm 38 years old, and I'm a Polish modeler. I would like to correspond in Polish or English, especially with modelers and computer enthusiasts from the U.S. and others countries. I hope you'll help me find a few pen pals. I hope there will be a few people out there who would like to correspond with me.

My hobby is building R/C models (electric and glow-powered airplanes), and I'm interested in giant-scale, gas-powered models, gliders, helicopters and R/C cars. I'm also very interested in ducted-fan models and would like to build one someday. My other interests are music, photography and IBM-compatible computers that I use in my workplace.

I'd like to exchange kits, model accessories and tools, magazines and books, floppy disks with model programs, etc. I also have a great collection of Polish stamps, Polish scale plans and "Plany Modelarskie"—working plans of full-size airplanes and ships for exchange. I also have "Maly Modelarz" brochures of paper scale models of airplanes and ships that you glue together like plastic models. If any interested modelers or computer enthusiasts write to me, I promise to reply to every letter.

MARIAN NAZIMEK
ul. Norwida 17 D / 7
46-200 Kluczbork,
Poland

Marian, we hope that someone will write and become your modeling pen pal. If any of our readers are interested in striking up a long-distance friendship with Marian, you can write to the address listed above.

GY ✦

HOW-TO ARTICLES WANTED

Do you have a construction technique, building method, or design innovation that you'd like to share with readers?

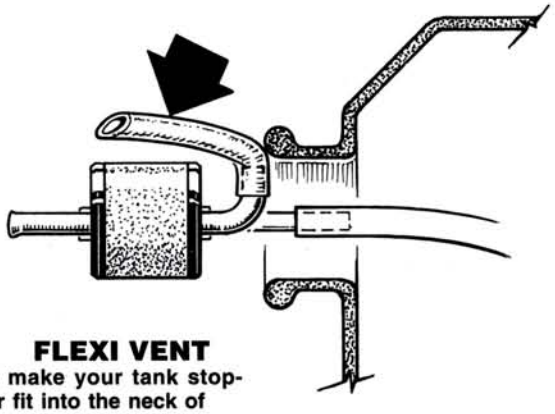
Why not publish your ideas in Model Airplane News?

For more information, contact assistant editor Debra Sharp (203) 834-2900.

Hints & KINKS

by JIM NEWMAN

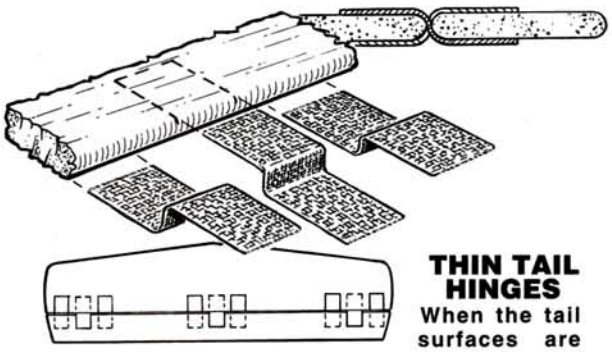
Model Airplane News will give a free one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



FLEXI VENT

To make your tank stopper fit into the neck of the tank more easily, shorten the metal vent-line tube as shown, and put a silicone-rubber fuel line over the end of it.

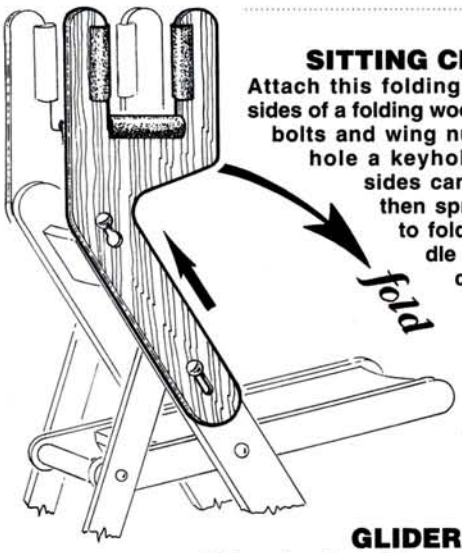
Terry Holtman, West Linn, OR



THIN TAIL HINGES

When the tail surfaces are too thin to make slots for hinges, use these simple fabric hinges from long ago. Make them out of thin nylon tape or Tyvek® strips cut out of express-mail envelopes. Such a hinge can be inserted when one of the regular glue-in hinges breaks; you don't want to have to cut the tail apart to insert new hinges (as happened to our columnist!).

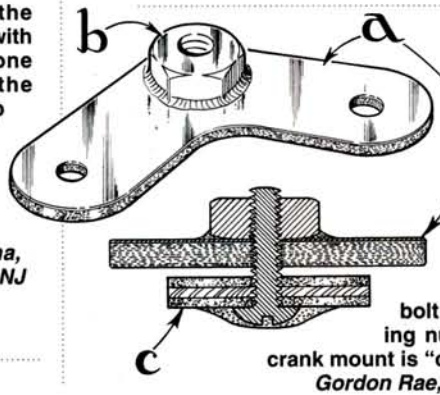
Himawan Nugroho, Surabaya, Indonesia



SITTING CRADLE

Attach this folding cradle to the sides of a folding wooden chair with bolts and wing nuts. Make one hole a keyhole so that the sides can be slid up then sprung clear to fold the cradle down for carrying.

John Keena, Whippany, NJ



THREADED CRANK PIVOT

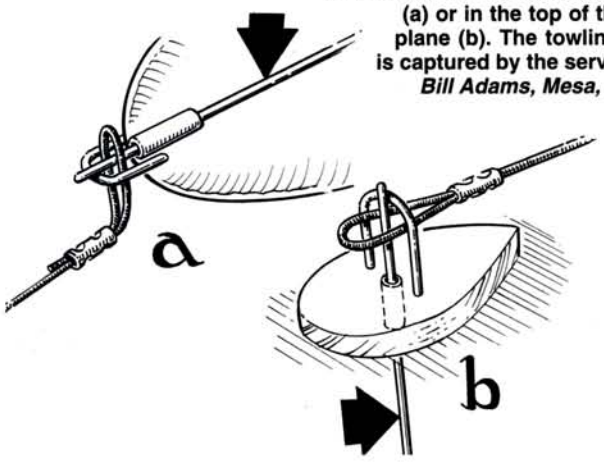
This is ideal for thin wings and other areas where space is restricted. Make bellcranks out of copper-faced circuit board (a), then solder a nut "b" to the board. The bellcrank can be threaded onto the pivot bolt and needs no further retaining nut or washers. The plywood crank mount is "c."

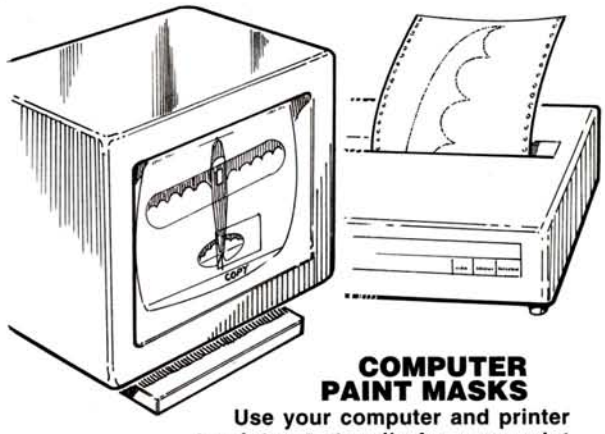
Gordon Rae, Malvern, Worcs., England

GLIDER RELEASE

This simple glider release can be installed in the nose of the glider (a) or in the top of the tow plane (b). The towline loop is captured by the servo rod.

Bill Adams, Mesa, AZ





COMPUTER PAINT MASKS

Use your computer and printer to plot out stencils for your paint scheme; you can view potential paint schemes on your color monitor. Cut out the stencil, spray it with a low-tack adhesive, then position it on the model.

Robert Fields, Tucson, AZ

EDITORIAL

by GERRY YARRISH

THE GIANTS RETURN

Every year, many modelers make the trek to Eldorado Dry Lake just south of Las Vegas, NV, to participate in the Quarter Scale Association of America (QSAA) International Giant-Scale Fly-In. They come from across the country and around the world—as far away as Bangkok, Thailand—to enjoy the sun and unlimited space afforded by this site. If you like your scale models really big—as big as ½ scale—check out Bob Banka's report.

The little biplane with a big name—the Pitts Special is a favorite with many people. Whether you're a scale modeler or just like airplanes in general, Budd Davisson's article on the Pitts is a feast for the eyes.

PSEUDO SCALE?

Here's an idea that's sure to elicit a heated response. Author Rupert Kosmala puts a new spin on scale—pseudo scale: a class for which you design, build and fly models that look as if they could be actual full-size airplanes, but they aren't. Sound weird? It isn't really. Today, there are many sport models that look very "realistic" but are not scale models of full-size planes. Every year at full-size aviation expos such as Lakeland, FL, and Oshkosh, WI, the Experimental Aircraft Association (EAA) highlights many new and originally designed homebuilt aircraft. A pseudo-scale model expo would closely resemble a miniature Oshkosh.

Pseudo scale combines craftsmanship, originality and creativity. Dyed-in-the-wool scalers might not like this approach, but for others, an event for which you design and build original-concept models that include all the rivets, screws and rib-stitching detail of full-size planes might just be the start of something big. The "Un-scale" concept is here. Read Rupert's article, and let us know what you think.

A LITTLE BIPE WITH A BIG NAME

The famous Pitts Special is a full-size biplane with a wingspan that isn't much larger than the span of some of the models flown at the QSAA Fly-In. Longtime Pitts owner and professional aviation journalist and photographer Budd Davisson delivers the ultimate Pitts Special biography.

From its simple, quiet beginnings to its latest fire-breathing incarnation as the Super Stinker, the little Pitts continues to be one of the most popular aircraft designs among modelers and full-size pilots alike. If you're in the market for a scale Pitts Special for your next modeling project, check out Budd's article. We've included many R/C kit manufacturers who offer Pitts Specials in various scale sizes.

ZIROLI'S SALAMANDER

We're pleased to feature another construction article by Nick Ziroli; this time, it's an electric-powered ducted fan—the Heinkel He 162 Salamander. This WW II Luftwaffe jet is a good performer. Traditional building techniques are used throughout, and its stripped, planked, round fuselage produces a light, strong, rigid airframe.

This design made its debut at the annual KRC Electric Fly in Quakerstown, PA. It should please scale modelers as well as "silent types." Electric jets are definitely here to stay.

ON FINAL

For fliers who need help "greasing in" that airplane, associate editor Roger Post's article "From Final to Touchdown" is a must-read. It clears up some of the confusion pilots encounter when landing their models. This well-illustrated article is worth reading several times.

With practice and by using the proper techniques, you'll soon be ending your flights with style. Enjoy!

by NICK ZIROLI SR.

MODEL AIRPLANE NEWS
CONSTRUCTION

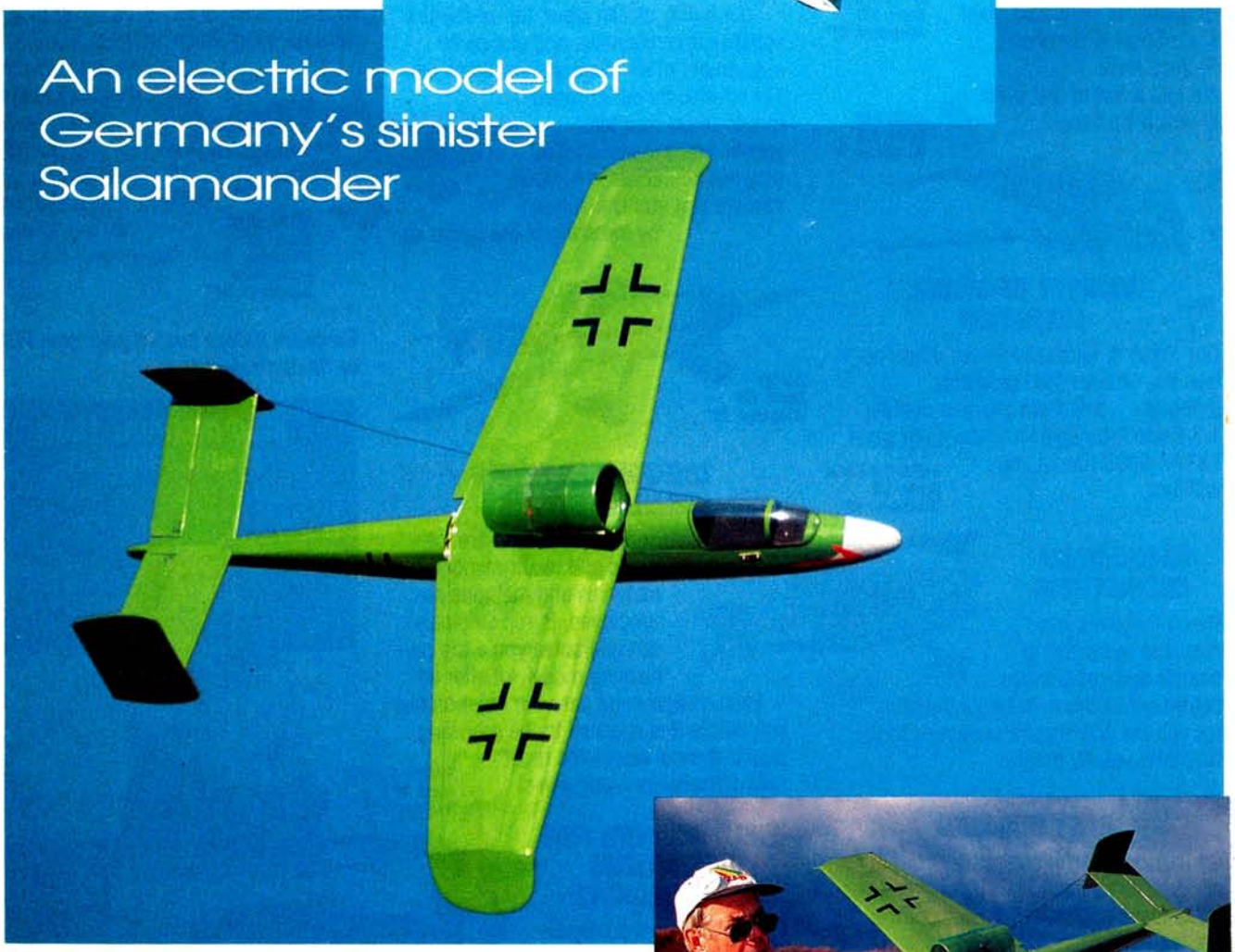
HEINKEL He 162

An electric model of Germany's sinister Salamander

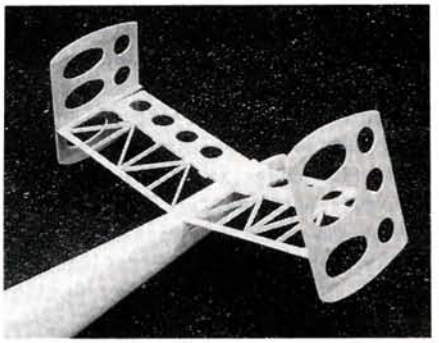
MY FIRST Heinkel He 162 Salamander was a .40 size that was developed in 1975 for the Jet Hangar Hobbies* Turbax I and Kress Jets* RK-40 fans (the RK-40 is no longer available). This was a very good flying model, and it was a good test model because the external engine-fan units were easy to modify or replace. Details were published in *Flying Models* magazine in November 1975, and it was later kitted by Midwest Products, but the kit is no longer available.

The second version was a 34-inch-span, 220-square-inch wing area, ½A-size powered by a Kress RK-049 ducted-fan unit. This also flew well and could take off unassisted, which was good for a ½A ducted fan. It was controlled with two channels; elevator and ailerons were linked to the nose-wheel steering. If anyone is interested, I have a set of finished unpublished plans for this model ($12 postpaid in U.S. from Nick Ziroli*).

This third version was prompted by my receiving one of Kress Jets' Electro Jet 3.33-inch electric ducted fans. I knew I would model the He 162, but I wasn't sure which size it should be, considering the power and weight of the motor and batteries. At that time, I had no expe-



Nick Ziroli with his Salamander.



The tail is of a basic stick-and-sheet construction—light and strong.

rience with electric power other than with the 05 can-powered gliders my brother built. I had seen videos of Tom Hunt (half of the Aberle/Hunt team at Modelair-Tech*), flying his modified Midwest Jetster powered by the Electro Jet 3.33. It looked as if it performed well, so I asked Tom for guidance on the size and weight I should aim for. His advice was good; the finished product presented here flies very well.

CONSTRUCTION

The model isn't difficult to build. The wing uses a flat-bottom airfoil, so it's easy to construct. The simple built-up and sheet-balsa tail surfaces are also very basic structures. On the other hand, the fuselage is a little more challenging, but I like the streamlined, scale-like representation of the full-scale He 162. I also enjoy working with balsa wood, forming and planking to get the most out of as little material as possible. With electric power, a light airframe is important because the battery contributes so much weight to the finished model. The 15-cell battery in the Heinkel amounts to a little more than 40 percent of the total weight.

• **Fuselage.** Cut the fuselage sides out of medium-hard, 3/32-inch-thick sheet balsa. Do *not* use anything that has even a hint of being "C"-grain—the type with short grain lines that is very rigid across the grain. The "C"-grain, or quarter-sawn, wood is the strongest for its weight, and it's a good choice for everything *except* the fuselage sides and the wing sheeting. The wood for the sides must be flexible enough (but not too soft) to conform to the formers and the tapered nose. The V-slit in the nose is there to allow the sides to form the compound curve required at the front end.

Glue the 3/32x1/4-inch balsa stringers and wing saddle into place on the fuselage sides. (Be sure to make one right side and one left side.) Mark the positions of the formers on the inside of each side. Join the sides at the tail with a 1/4-inch block spacer and at former F-5. Use masking tape to hold the sides against the formers, then glue them with a CA glue such as Zap*. Make sure the two sides are in line with each other when viewed from the side.

Install formers F-6, 7, 8 and 9. Hold each side with tape so that it curves around the formers. If necessary, dampen the outer surface of the sides to help them conform. Add the rest of the formers from F-4 to the nose. When the sides are fit to formers F-1 and F-2, the V-slit in each side should close. Be careful not to build a twist or curve into the fuselage. Install the elevator pushrod tube, and add the battery-box sides and bottom. The battery box sides bend outward to meet the fuselage sides between F-3 and F-4.

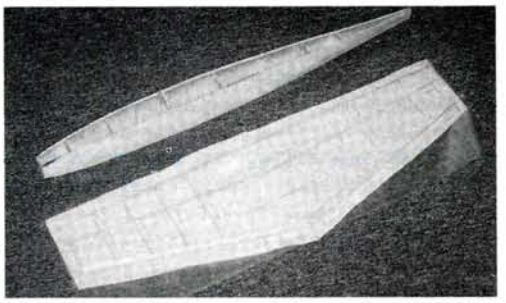
Cover the bottom of the fuselage with strips of 3/32x3/8-inch balsa. Start at the edge of the sides, and add planks, working toward the center of the bottom. At the nose and tail, taper the planks to fit—not as difficult as it sounds.

At this point, install the elevator servo and pushrod. Wrap and solder the dual, 0.045-inch-diameter, wire pushrods to a short piece of 2-56 threaded rod. From the inside, install this assembly through the pushrod tube, and screw the inner plastic rod onto the threaded "Y." Use a threaded Z-bend coupler at the servo. I installed small plastic control links by thickening the wire with solder where it meets the links and filing it down to fit tightly over it. After the stabilizers and elevators have been installed, the links are pressed into the neutral-elevator position and then "Zapped" into place. I would never do this on a larger model, but it worked well on this one. Adjust neutral by screwing the servo coupler into or out of the inner plastic pushrod.

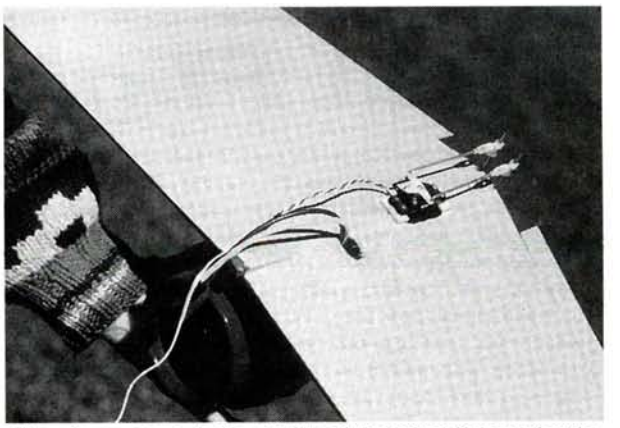
SPECIFICATIONS

Wingspan: 43 in.
Length: 42 in.
Wing area: 330 sq. in.
Weight: 50 oz.
Wing loading: 21.5 oz. per sq. ft.
No. of channels req'd: 3 (throttle, elevator and aileron)
Power: Kress Jets Electro Jet 3.35 or equivalent with 15, 1100mAh cells (18 volts)

Comments: the Heinkel He 162 Salamander flies well and is not difficult to build, but its "round" fuselage requires strip-balsa planking. Proper wood selection will result in a strong, light model that can either be hand-launched or bungee catapult-launched. Flights typically last 3½ minutes; throttling back from full power will extend flight times.



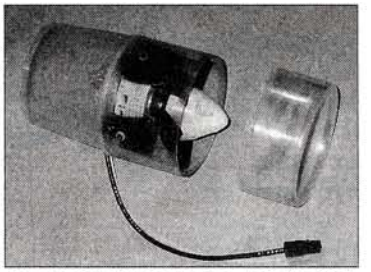
The wing and fuselage early in construction. Note that you start the wing by placing the leading edges, bottom sheeting, capstrips and spars over the plans.



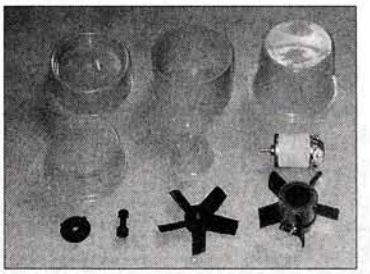
The aileron servo in the middle of the wing; linkage for the strip ailerons—simple setup.

The Kress Jets Electro Jet 3.33 was very easy to assemble. The parts fit well and, apart from the first-flight spinner problem and seventh-flight capacitor problem, the unit has been trouble-free.

KRESS ELECTRO JET



The assembled Electro Jet ducted-fan unit.



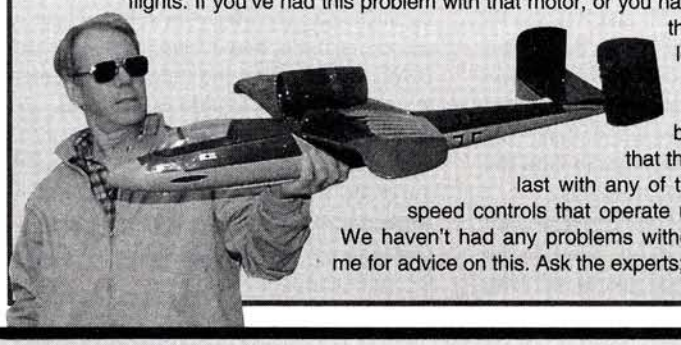
I used the Kress inlet ring and tailpipe—very light, well-designed, vacuum-formed pieces. The front inlet is glued to the main duct, and the tailpipe is held in place with clear tape. To remove the motor, the fan must also be removed from the duct so that the motor can be pushed out through the rear of the center body. The motor doesn't have to be removed very often, so this isn't a problem.

The completed ducted-fan unit was glued into place with Zap-a-Dap-a-Goo. Make sure it's on right, because it's there to stay. I deliberately omitted one of the screws that hold the center body and stators in the outer shroud tube. This hole is against the wing, and the four screws I did install are accessible if I have to remove the center body.

The ducted fan is attached to the wing using Zap-a-dap-a-Goo adhesive.

On about the seventh flight, there was a loud bang like a rifle shot and a puff of white smoke from the exhaust duct. The motor lost power and we landed. On inspecting the motor, I discovered that the large electrolytic capacitor that serves as an arc suppressor had exploded. A call to Bob Kress at Kress Jets brought an explanation of the problem. Bob had been using a 47-microfarad, 16V capacitor, which, at the lower voltages he was running on earlier, had worked fine. On the higher voltage being used here—a nominal 18 volts, but 21.5 volts right after a charge—the capacitor was being overloaded. Kress has replaced this capacitor with a 100-microfarad, 50V one that should take care of the problem.

Bob said that Tom Hunt had the same problem after approximately the same number of flights. If you've had this problem with that motor, or you have one that contains the smaller capacitor, let Kress Jets know. They'll send a new one at no charge because they think that this capacitor may not last with any of the newer, high-rate speed controls that operate up around 4000cps. We haven't had any problems without it. Don't contact me for advice on this. Ask the experts; I design airplanes.



Complete the nose by adding the blocks and carving and sanding them to shape. Cut the cockpit floor to shape and add formers F-3A and F-4A. Cover the top with 1/16-inch sheet balsa. To increase the gluing-surface area, glue a strip of 1/8-inch-thick balsa along the edge of the cockpit where the canopy will be attached. Paint the cockpit area with black paint. Trim the canopy and glue it into place only on the removable hatch. Holding the hatch in position, with a 1/8-inch-diameter bit, drill through the holes in F-5 into F-5A. Glue two short pieces of 1/8-inch dowel into the holes in F-5A. The front of the canopy is held down with a small sheet-metal screw that goes through the canopy and into a small 1/8-inch plywood tab in the top nose block. Cut the slot for the plywood tab, but don't glue it into place until the fuselage has been covered. Glue the rear-wing hold-down block into the fuselage. Cover the top of the fuselage with 1/16-inch sheet balsa, then add the tail block and sand to shape.

The gun ports in the fuselage side serve as air vents for the heat-generating motor battery. I made them out of 1/2-inch-diameter model-rocket tube. The holes must be tapered so the tubes will fit properly. Sandpaper wrapped around a 3/8-inch dowel is a good tool for shaping them. I left space behind the wing for air to exit.

• **Tail and wings.** Build the stabilizer over the plans. For the leading and trailing edges, use fairly hard 3/16x1/4-inch balsa. Join the stab halves so that they have 1 1/2 inches of dihedral under each tip. Cut the elevators out of 1/8-inch balsa and the fins out of 3/32-inch balsa. Hinge the control surfaces with strip-plastic hinges cut to a width of 1/2 inch. Do not glue the hinges into place or join the fins to the stabilizer or the stab to the fuselage until you've covered the parts.

The wing is built flat on the building

First Flight

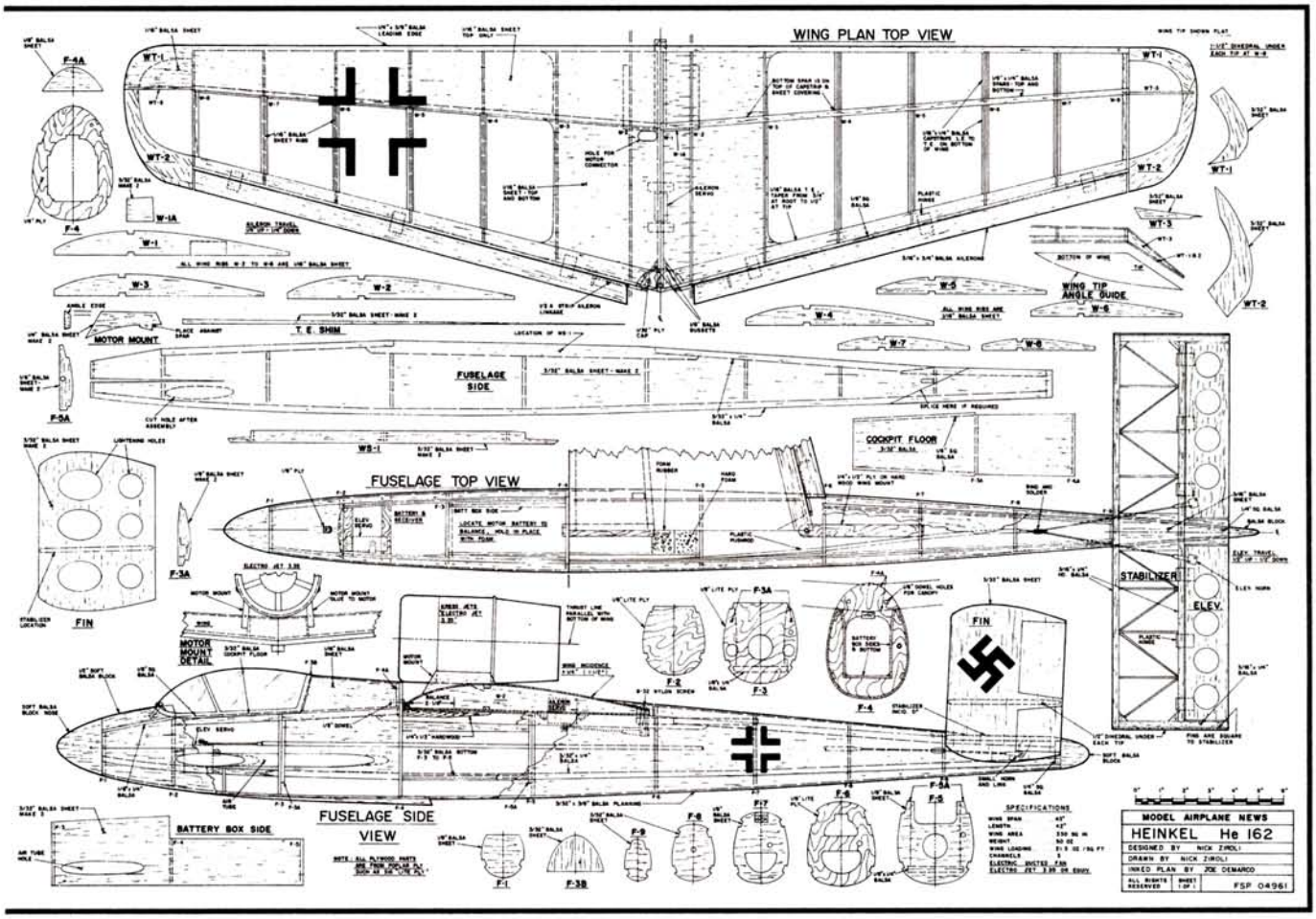
I finished the He 162 a few days before the 16th Annual KRC Electric Fly in Quakertown, PA. I though the trip would be worthwhile to see firsthand the electric experts in action and get good advice. Well, it was worth the trip. There were all types of electric-powered models, from the most basic to really inventive, original designs up to Top Gun-quality scale models.

I don't know how many models there were, but I registered at around noon on Saturday and was pilot number 172. I never saw so many transmitters in an impound area! All the big names in electrics were there (Shaw, Kopski, Poling, Sribnick, Aberle, Hunt, Kress and many others). I hope to be there again this year.

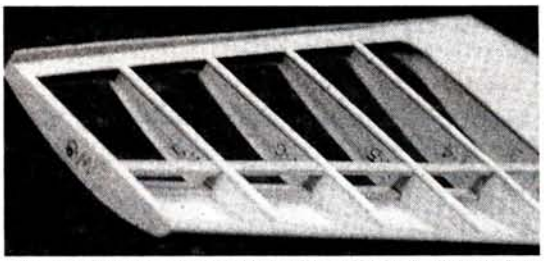
I generally don't advise that anyone test fly a new model at a fly-in, but with all the know-how there, how could I go wrong? Fortunately, my flight line was at the upwind end of the field, so we would be hand-launching clear of obstacles. I was confident that the model would fly, because two previous versions had flown well. My main concern was its power-to-weight ratio.

Tom Hunt had experience hand-launching his Jetster (similar configuration) so he took care of the first launch. It was good, but flight performance was very disappointing. The Heinkel was powered by 18 volts (a 15-cell, 1100mAh battery), which turned the motor and fan at over 22,000rpm, yet I could barely keep it in the air. After a couple of circles around the field, I landed it. What was wrong?

After a post-flight discussion and some head-scratching, it was obvious to everyone exactly what the problem was. I assumed it would be best to cover as much of the rotor hub as possible with



board from the bottom up. Cover the plans with wax paper or plastic wrap. Pin down the 1/4x3/8-inch leading edge, 1/16-inch trailing edge, 1/16x1/4-inch capstrips and 1/16-inch center-section sheeting over the plans. There isn't any leading-edge sheeting on the bottom outside rib W-3. Install the 1/8x1/4-inch bottom spar on top of the capstrips, and then add all the ribs. Use rib W-1A to set the angle of W-1. Pin the leading edge to the plans, and lift the trailing edge so that a tapered trailing-edge shim can be placed under it and tack-glued to the wing. This will build in the required washout as the wing is completed. Add the top spar, 1/8-inch-square trailing edge and the 1/16-inch trailing-edge top. Cover the top leading edge and the center section. Cut slots so that the motor mounts will protrude through the top covering because they also serve as guides when you mount the ducted-fan unit.

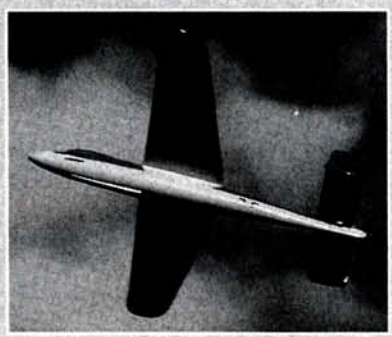


The wing uses flat-bottom ribs for easy, "over-the-plans" construction.

Remove the wing from the plans. Keep the trailing-edge shim in place. Shape the leading edge, and clean up the wing with sandpaper. Join the wing panels so that

the vacuum-formed spinner, and I had carefully cut away material to fit the spinner over the five blades. This was the cause of the poor first flight; when the motor was at full speed, those little flaps between the rotor blades were spreading straight out and blocking off half of the rotor diameter.

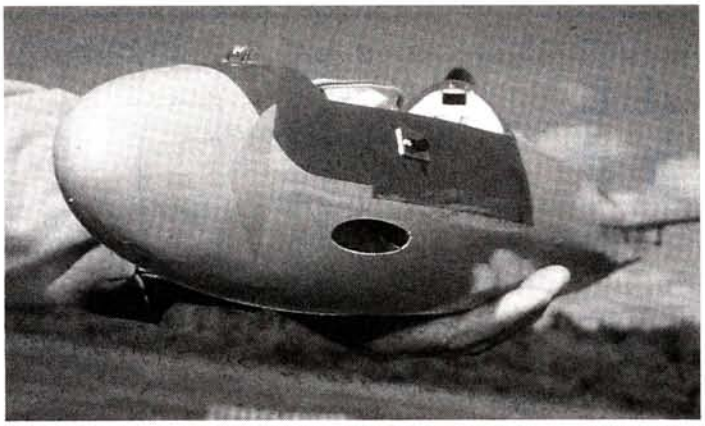
I cut off the rear part of the spinner and reinstalled it, and the Heinkel's second flight was more like I had anticipated. Climb-out after launch was very good, and the aircraft could execute big loops from level flight. At half power, it cruised very nicely, and flight time was considerably extended. Using a mixture of full power and "cruise" yields flight times of around 3½ minutes. The airplane/fan systems are a good match and complement each other.



I didn't like hand-launching the Heinkel. It isn't a powered glider, and takes a pretty good heave at the correct attitude to ensure a successful launch. It would be better to use a simple bungee cord to boost it into the air. I added a plywood skid to the bottom of the fuselage, and it also serves as a launching hook. The "bungee cord" is actually many no. 64 rubber bands looped together. One end is staked to the ground; the other is hooked on the skid and pulled as tightly as the rubber will allow. When released, there should be enough speed to get the Heinkel airborne. This has solved my launching problem very successfully.

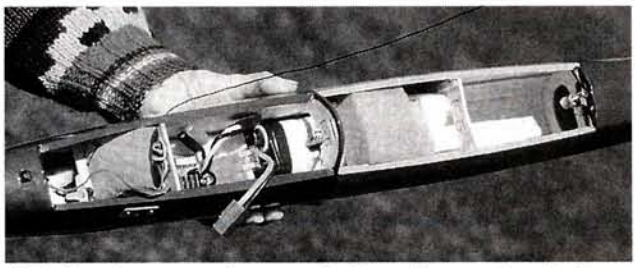
they have 1½ inches of dihedral under each tip at W-8 (or, with one panel flat on the table, there should be 3 inches under the other tip).

Remove the tapered trailing-edge shim. Assemble wingtips WT-1 and WT-2, and glue them into place using the angle guide to set them. Add WT-3 and the 1/16-inch top covering. Sand the tips to shape. Sand a flat spot at the dihedral break where the 1/4x1/2-inch, hardwood, front-wing hold-down block will be, and epoxy the block securely into place. Fit the wing to the fuselage. To allow the wing to sit properly on the fuselage, you have to do some filing in the top of the slot in F-5. When the wing is in place, the mounting block should fit tightly in the slot, but should not be under stress.



The gun ports (cardboard tubes) in the fuselage sides are air inlets to cool the drive batteries.

Align the wing and, using an 1/8-inch-diameter bit, drill through the 1/32-inch plywood plate and the wing and into the mounting block in the fuselage. Tap the fuselage block with an 8-32 tap, and open the hole in the wing to 11/64 inch, or use a no. 18 drill bit. Harden the threads in the block with thin Zap, and re-tap the hole when the Zap has cured completely. (Be sure it has cured, or the tap will become part of the airplane.) Use an 8-32x3/4-inch plastic wing-mount screw.



With the wing removed, access to the radio, speed controller and batteries is easy.

Mount the aileron servo, and trial-fit the 3/16x3/4-inch ailerons with plastic strip hinges and a 1/2A aileron-linkage set. Don't install the ailerons permanently until after the parts have been covered. Epoxy the 1/4-inch ducted-fan mounts into place in the holes against the wing spar. This should position them properly so that the thrust line is parallel to the bottom of the wing. Bevel the inside of the mounts so that the fan unit is seated properly. Be sure the thrust line is parallel to the bottom of the wing. Do not install the ducted fan until you've covered the model.

FINISHING

To save time and weight, cover and finish the Heinkel in one operation with one of the available plastic film coverings. There isn't much choice for a color scheme here. All the references I've seen have been "light gray bottom with green top surfaces." Top Flite* MonoKote comes in these colors, and I used it with good results. Before applying any film covering, I always give the wooden surfaces a coat of Coverite's* Balsarite.

Cover all the separate parts, but cut away the covering where parts will be glued to other parts. I applied the Dove Gray first, then the green and, finally, the black crosses and red arrows (also MonoKote). To complete the He 162, assemble all the finished parts and hinge the control surfaces.

To protect the MonoKote during landings, I applied a piece of approximately 1-inch-wide, clear-plastic packing tape to the bottom of the fuselage from the nose back to the middle of the wing. I "Zapped" the 1/4-inch plywood skid to the tape, and installed a 9-inch Sig* canopy after first cutting it to shape for the model.

I used a Lofty Pursuits* model LPSC-1 speed control and Sermos* connectors with excellent results The speed control operated just as advertised and will handle up to 50 amps—about twice the current required for this application. The motor runs off a square pack of 15, 1100mAh cells made of three rows of four cells and one with three cells. I use a TRC Engineering* Impulse 4 charger to charge

Heinkel's Salamander

In WW II, the full-scale He 162 Salamander was an interesting last-ditch effort by the Luftwaffe to get a high-performance jet into the air. They were looking for the performance of the twin-jet Me-262 while using cheaper, non-essential, construction materials in a design that could be built quickly by relatively unskilled workers.

The prototype was designed and built in three months. (Try that today, even with a model.) The wings, tail parts and some of the fuselage parts were made of wood and were to be subcontracted to small shops and furniture factories throughout Germany. The ill-fated prototype crashed because of poor wood-glue joints on the wing's leading edge, but only two apparent changes were made to production versions. The fin and rudders were enlarged to increase yaw stability, and the drooped wingtip extensions were added to reduce the aircraft's tip-stalling tendencies. About 170 planes reached the front lines, but lacking fuel and service, they never saw action. At the end of the War, close to 1,000 were found in various stages of completion.

PHOTO COURTESY—THE AVIATION PICTURE LIBRARY

Over-turn correction for left turn

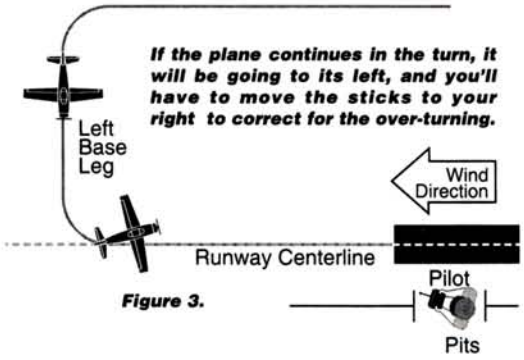


Figure 3.

Under-turn correction for left turn

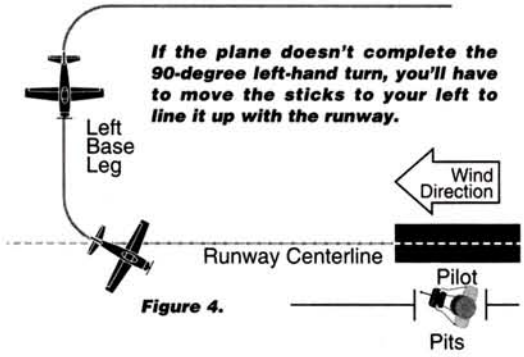


Figure 4.

• **On final, with your back to the plane.** If you are looking over your shoulder) during the turn to final, your right will be the plane's right and your left will be its left, so making corrections should be easy. No matter which way you land, this description will always be the same; so keep this in mind at the end of each approach discussion.

You should never start out facing the plane and then do a 180-degree turn with your body to reorient yourself. This will only double your confusion and make your flying buddies wonder whether you've been taking dancing lessons. Stick with one technique and perfect it.

FINE-TUNING THE FINAL APPROACH

Now that you have successfully lined up with the runway, your plane will probably be approximately 150 feet out and 30 feet high. If there isn't any wind and you've trimmed the plane perfectly, the power setting you've selected should allow you to land your plane right on the runway....

OK, let's get back to reality. If you find that your plane is going to land short, add power (*power is altitude*). If there's a headwind, keep some power on; the stronger the headwind, the more power you'll need. Let's now consider fine-tuning with rudder to maintain alignment on final.

• **Final approach—right to left.** If, on the approach path, the plane's centerline is not quite parallel to the runway centerline (but the wings are level), you should correct this with the rudder.

• If you *move the rudder stick to your right*, the plane will fly out to the field (see Figure 5, plane A).

• If you *move the rudder stick to your left*, the plane will come in to the pits (see Figure 5, plane B). Practice this lining-up procedure by imagining the runway centerline about 100 feet out from you and parallel to the *actual* runway centerline. Also, practice imaginary landings at an altitude of 20 feet or so to get used to the way your model responds. This procedure will prevent you from flying over or landing in the pits, and it will prevent you from hitting that ever valuable safety fence (very hard on the plane). Once you have mastered the directional control, you can line up your plane on the actual runway centerline and land.

• **Final approach—left to right.** When the plane is on the far side of the runway centerline, *moving the rudder stick to your right* will bring the plane closer to you (see Figure 6, plane A), and *moving the rudder stick to your left* will make the plane go out to the field (see Figure 6, plane B). To gain confidence with the left-hand approach and lineup, practice the previous lining-up procedures 100 feet out from the centerline.

Right turn centerline correction

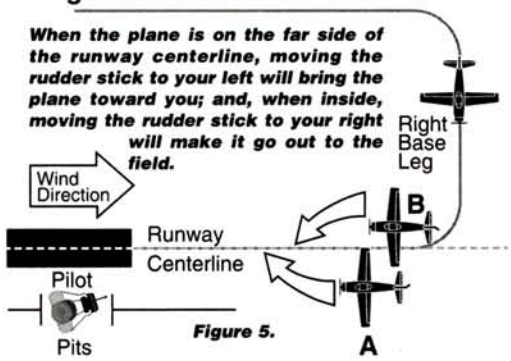


Figure 5.

Left turn centerline correction

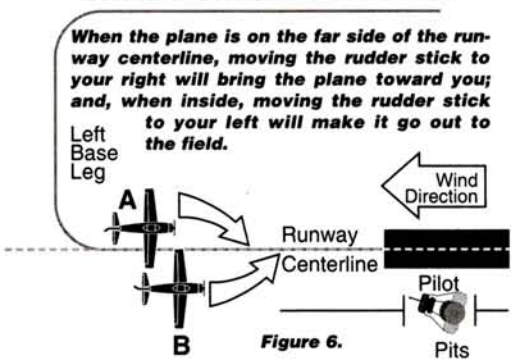


Figure 6.

FINAL WITH A TWIST

The dreaded crosswind! Whether a crosswind is from the right or left, the key element is *aileron into the wind.* To understand what this means, place your plane so that it is parallel to the centerline (do this in the pits, engine off) and stand behind it.

• When the crosswind is a quartering headwind from the plane's right, *move your aileron stick to the right.*

• When it's quartering from the plane's left, *move the aileron stick to the left.*

This is what is meant by "aileron into the wind." The crosswind's velocity and its angle to the runway and the model's airspeed during the approach will determine how much aileron into the wind is needed.

• **Right-hand turn to final.** If there's a crosswind from the plane's right, it helps to turn the nose of plane a little past the runway centerline and then continue the approach at a slight crab angle. The greater the crosswind's velocity and the larger its angle, the larger the crab angle needed. You can hold the crab angle, with varying amounts of right aileron and right rudder, by *moving both sticks to your right.*

The trick to maintaining a straight approach path with a crab angle is to keep some power on (25 percent or so) and don't "freeze" the sticks. You'll have to compensate for changes in the wind velocity and direction, and this requires small stick movements.

• If the plane starts to flip or drift toward you, add right aileron (move the *aileron stick to your right*).

• If the plane's right wing starts to drop, you'll need to momentarily *move the sticks to your left to lift the low wing* (see Figure 7, plane A).

As you get closer to the touchdown point, you will want to cross-control the plane about 20 feet before touchdown. This is to straighten the plane's alignment with the runway at the moment of touchdown. Cross-controlling requires that you move the rudder stick to your left while the aileron

stick continues to hold right aileron (*sticks pulling apart*). Your plane should now have a slight right-wing-low attitude, and the fuselage should be parallel to the runway centerline.

• If the nose is pointing toward the open field, add more left rudder (*move the rudder stick to your left).*

• If the nose is pointing toward the pits, take out a little left rudder—*move the rudder stick to your right (see Figure 7, plane B)*.

Your plane is now in a side-slip (it is slipping sideways through the air mass); remember to increase the control-surface deflections as the airspeed gets lower (practice this as before: 100 feet out and 20 feet high).

Right crosswind landing

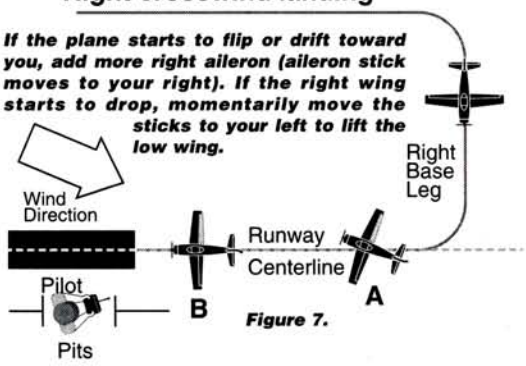


Figure 7.

Left crosswind landing

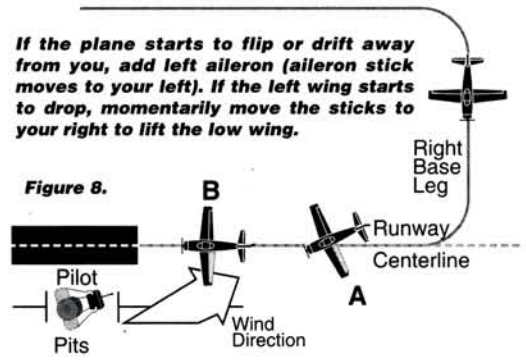


Figure 8.

When the crosswind is coming from the plane's left (right-to-left approach), you should almost complete the 90-degree right-hand turn from base leg to final—but not quite. Fly the approach with the plane's nose pointed slightly toward you (left of the runway centerline). It will now have a left crab angle, so you'll have to input varying amounts of left aileron and left rudder (*move the sticks to your left)* to maintain the crab. As before, keep some power on, and don't "freeze" the sticks.

• If the plane starts to flip or drift away from you, add left aileron (*aileron stick moves to your left).*

• If the plane's left wing starts to drop, you'll have to momentarily *move the sticks to your right* to lift the low wing (see Figure 8, plane A).

When cross-controlling for the left crosswind (left wing a little low), the sticks are pushed toward each other (*aileron stick goes to your left and rudder stick goes to your right*). To align the fuselage so that it's parallel to the runway centerline, add right rudder—*move the rudder stick to your right* (see Figure 8, plane B). Too much right rudder will yaw the plane's nose to the outside of the centerline, and too little will make the plane head toward the pits.

• **Left-hand turn to final.** When the crosswind is coming from the plane's right, don't complete the 90-degree turn from base leg to final (the plane's nose is slightly to the right of the centerline). Then establish a right-hand crab angle by *moving both sticks to your right.* Follow the previously given recommendations with respect to power and varying stick inputs.

• If the plane starts to flip or drift away from you, add right aileron: *move the aileron stick to your right.*

• If the plane's right wing starts to drop, add left aileron and rudder: *move the sticks to your left momentarily* (see Figure 9, plane A).

Then side-slip the plane for a perfectly aligned touchdown, with right aileron—*aileron stick to your right*—and left rudder—*rudder stick to your left* (see Figure 9, plane B).

When the crosswind is from the plane's *left*, you'll have to turn the plane's nose past the 90-degree turn and slightly to the left of the centerline—*sticks move to your left*—and establish a left crab angle on the approach path.

• If the plane's left wing starts to drop, momentarily *move both sticks to your right to lift the low wing.*

• If the plane starts to flip or drift in toward you, add more left aileron: *move the aileron stick to your left* (see Figure 10, plane A).

To cross-control for the landing, use left aileron—*move the aileron stick to your left* —and right rudder: *move the rudder stick to your right* (see Figure 10, plane B).

In all the lineups and approaches, be careful not to *over-control* the plane by slamming the sticks from side to side. Before you make a correction, always wait to see where the plane "settles," then make small correction inputs.

Right crosswind landing

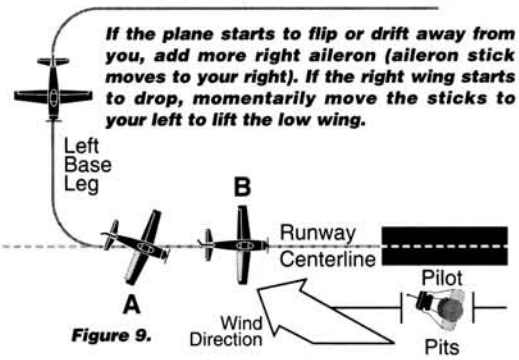


Figure 9.

Left crosswind landing

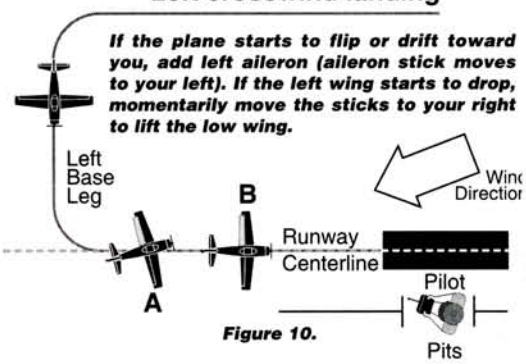


Figure 10.

ALTITUDE AND AIRSPEED

• **Power is altitude**. When the plane is too high on the approach path but is lined up correctly, reduce the power. If you have reduced the power and the plane is still too high, forward-slip it by increasing the cross-control inputs described earlier. To get the plane to achieve the forward slip, you'll need a little more rudder input than aileron input.

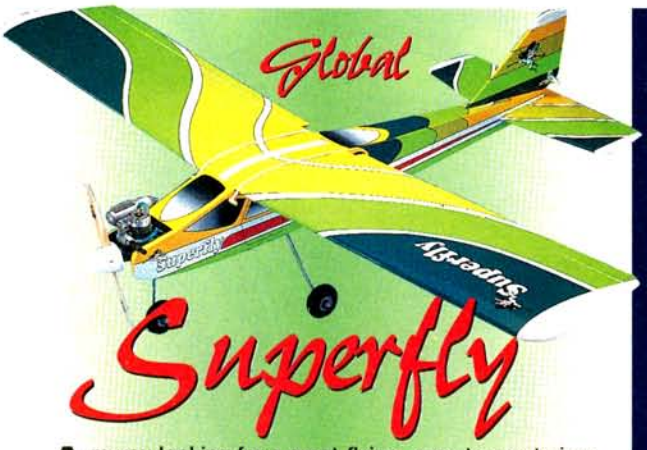
• **Pitch is airspeed.** If the approach speed is too hot and the throttle is at idle, pitch the nose up to slow the plane down. If this doesn't work, go around and slow down earlier in the landing pattern.

Now set this article aside; then come back to it and read it two or three times to let these control inputs "sink in." Also, take your plane out and either place it on the ground or have a flying buddy hold it (engine off) and practice these techniques. This will help your thumbs become familiar with the proper inputs, and it will spare you from some hair-raising moments when you fly. Good luck!

AirSCOOP

by CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!



Superfly

Are you looking for a great-flying, easy-to-see trainer that isn't too big? Global's new Superfly 15 ARF just might be the plane for you. Because of its great-looking paint job, it's almost impossible to become disoriented, and its semisymmetrical airfoil makes it stable yet aerobatic enough for a lot of "high-rate" barnstorming fun. With a span of 45 inches (363 square inches), the Superfly is 35 inches long and weighs only 2.75 pounds. The .15-powered trainer requires a 4-channel radio and, even though it has a non-steerable, tricycle landing gear, the model has plenty of rudder authority, so takeoffs are very easy. The Superfly comes completely factory-built and covered, and even a novice will find the assembly fast and easy. For more information, contact Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133.

Midwest Giles 202

Following hot on the heels of their Super Stinker aerobatic bipe and the Super Stearman, Midwest's newest offering is the Giles G-202, available in June '96. Manufactured by AkroTech Aviation, the full-size G-202 (shown here with Midwest's Mike McConville) is a two-place version of the all-composite Giles G-200 unlimited aerobat. The full-size Giles G-202 has the fastest roll rate (500+ degrees per second) of any competition aerobatic aircraft. Designed by Mike McConville, the new G-202 is typical of Midwest's excellent construction and kit quality. It will have a 72-inch span (960 square inches), and it's perfect for popular 1.20 2-strokes such as Webra's. It can also be powered by the YS 1.20 4-stroke and the new Saito 1.82 4-stroke. If you liked the Midwest Extra 300, you'll love the Giles G-202.

JR XPS103

Our spy in Japan just sent us this picture of JR's newest radio. Soon to be available here in the U.S., the new JR XP8103 (seen here as the X-3810 for the Japanese market) will have a new faceplate and the same programming. This 8-channel, 10-model-memory radio with three aircraft programs (heli, airplane and glider) is said to be even easier to use than the popular JR X-388. JR promises to have some of these new radios on hand at the Toledo trade show in April. We'll keep you up to date as we learn more about this new addition to JR's programmable radio collection.

AIR SQUADRON SCORE CARDS

For the warbird lover who has everything, these new scorecards are a great source of wartime information. Introduced in 1995 to commemorate the 50th anniversary of WW II, Air Squadron Scorecards include information on aircraft, squadrons, operations, losses and unit-award citations. The cards also include facts on ground attacks, a tally of squadron aces and damage done to enemy aircraft and ships. Shown here is the VF-27 Hellcats squadron—the second scorecard in a series that promises to be of great historical value to aviation enthusiasts and collectors. For more information, contact Air Squadron Scorecards, P.O. Box 57556, Lincoln, NE 68505; (800) 646-4734.

Engines on CD

Lifelong model-engine collector James Newland of Scotts Valley, CA, needs your help. Thirty years ago, he started to compile a list of the world's model engines and, recently, he decided to catalogue his own engine collection. He was surprised to find that he had 387 engines, and he decided to include all the information he could collect on engines and put it on CD-ROM. At present, the CD includes two very large files: ENGINE.LST and MANUF.LST in simple ASCII text files. There are also some video-frame captures of all the engines in his collection.

Jim would like to hear from other model-engine collectors and enthusiasts. He would be happy to supply an engine list to anyone who would like to assist him with his engine information and archive project. If you'd like to help, contact Jim at 317 Oak Creek Blvd., Scotts Valley, CA 95066.

The Ziroli Avenger

Everything that comes out of Nick Ziroli Jr.'s Long Island, NY, hangar is sure to be an eye-opener. The aircraft Nick chooses to model aren't your everyday warbirds. Nick decided that his project for 1996 had to be *really* special, especially if he was going to compete with it at Top Gun '96. His newest competition weapon—the Grumman TBM Avenger—includes a retractable landing hook, folding wings and operating torpedo/bomb-bay doors. Powered by a Precision Eagle 4.2 gas engine, the Avenger has a 108-inch wingspan, and it will include the same attention to detail (rivets, screw heads, panel lines and weathering) that made his Hellcat such a winner.

Even unfinished, the model looks impressive. Good luck, Nick; the competition awaits!

NEWS FLASH!

OPS Joins Great Planes

Great Planes Model Distributors has added OPS engines to its line of exclusive products. Made in Milan, Italy, OPS engines have a 27-year reputation for performance and quality. Famous in boat racing, OPS also brings this excellence to R/C airplanes. For more information, contact Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300.

A special announcement from the publishe

INTRODUCING

FLIGHT–

a new magazine that explores the aviation adventure!

From the people who bring you *Model Airplane News* comes a new and unique quarterly magazine that captures all the drama, the history, the technology and the timeless adventure of aviation and aircraft. Introducing FLIGHT magazine!

FLIGHT looks at the world of aviation in an upbeat, captivating style that puts you right in the cockpit. From the first powered flights to WW II's Warbirds to the aircraft of today, from the compelling stories of man's brave experiences in the air to the technical details of a P-51B or Stealth Fighter, FLIGHT brings you the very best of full-scale aviation.

FLIGHT is for everyone–enthusiast, modeler, historian and pilot–who cherishes the drama of man and his flying machines.

Join us as a Charter Subscriber

As a reader of *Model Airplane News*, you're invited to accept this charter subscription offer to FLIGHT. Return the attached card today to become a charter subscriber, and you'll receive a year of FLIGHT– including the premier issue (published in April)–for only $14.95. We'll bill you later.

And here's another bonus: enclose payment with your charter subscriptic and you'll receive an extra issue– five superb issues in all–for the same low price of only $14.95.

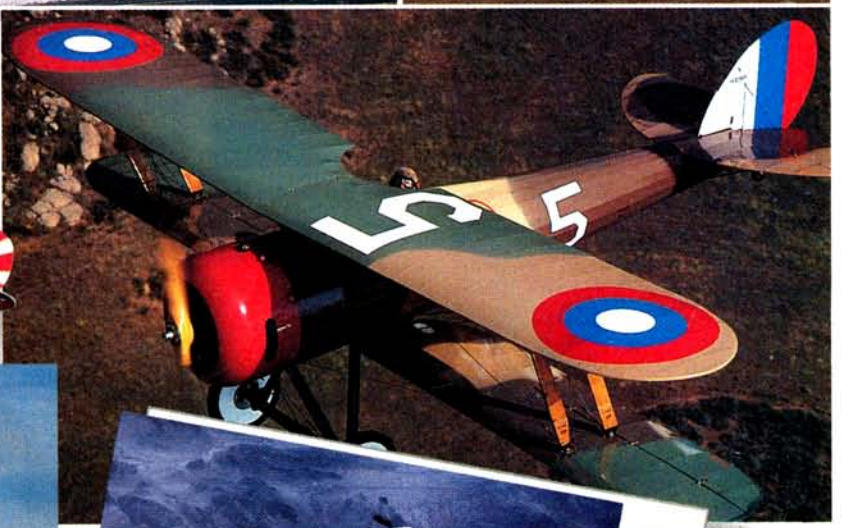
We guarantee you'll discover FLIGHT brings you the same high-quality content, the same entertaining reading, that you've come to expect from *Model Airplan News.*

Subscribe to FLIGHT now, and explore the aviation adventure!

Model Airplane News...

FLIGHT brings you:

- *Coverage of aircraft, from the Wright Flyer to the P-38 to the B-2.*
- *Stunning aviation photography.*
- *Three-views, detail photos and color schemes for modeling.*
- *The great personalities and human adventures of aviation.*
- *Visits to air shows and aviation museums.*
- *"Virtual flight"— the computer flight-simulation experience.*
- *The diversity of aircraft, from military to commercial to aerobatic.*



A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable. We receive so many photographs that we are unable to return them.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1996. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035.

POSTCARD FROM DOWN UNDER

Hans Janota of Sydney, Australia, built this 1/4-scale Extra 300—christened "Skybeast"—from an Ernst Eggan kit. The 94-inch-span, 19 1/2-pound model is powered by a 5.2ci Sachs Dolmar engine turning a 22x12 Bolly prop, and it's decorated with six shades of Standox Pearl over a white base and three coats of clearcoat. Peter Kent photographed the model against the backdrop of Australia's Sydney Harbour Bridge.

LAZY *DUCK?*

Earl Brightbill of Roswell, GA, sent this photo of his 108-inch-span electric model next to Frank Morgan's 40-inch-span Lazy Bee. Earl adapted the wing from Clancy Aviation's Lazy Bee, and he made the fuselage using Tom Chipley's Giant Mud Duck plans. The 15-pound model is powered by an Astro 60 sport wind motor with a Modelair-Tech H-1000SP 2.86:1 reduction belt drive on 30, 1700mAh cells. The prop turns at 3,600rpm and draws only 17 amps. Earl says that his Duck can take off in about 30 feet, and it flies very slowly.

WHAT'S A WANABEE?

Marty Petri of Northridge, CA, says that his 92-inch-span Wanabee simply wants to be looked at. It isn't a scale model of anything; it's a heavily modified version of a friend's scratch-built Air Cruiser with added Ikon N'West Stinson tail feathers and cowl. A Quadra 35 turning an 18x6/10 prop keeps the 28-pound bird aloft. Marty's Wanabee sports a Flite-Lite lighting system, and it won the People's Choice Award at the London Bridge Seaplane Classic sponsored by the Desert Hawks of Lake Havasu City, AZ.

THAI BEARCAT

This F8F is the handiwork of John Carlson of Tulsa, OK. He started with a Royal kit and added foam-core wings, recessed hinge lines on the control surfaces, functional cowl flaps and homemade pneumatic retracts. He glassed the model with 3/4 and 1/4-ounce cloth and polyester resin and used spray paint for the base coat. Some of the 3rd Fighter/Bomber insignias of the Royal Thai Air Force were hand painted; some were replicated with MonoKote trim and decals. John also added all the panel lines and rivets.

POLISH THERMAL SNIFFER

Maciej Krajniak of Gniezno, Poland, says "Hallo from Poland! It's me and my favorite model, Vega Thermik." The 100-inch-span glider has balsa wings and a fiberglass fuselage, and it's powered by an Enya engine. A Futaba Attack 4 radio controls the model's elevator and rudder.

A BOY AND HIS PLANE

Three-year-old Zachary Schaefer of Edgewood, NM, just can't wait to see this beauty in the air! His dad, Paul, built the 1/6-scale Fokker D-7 using a Sterling kit, covered it with Solartex and hand-painted the lozenge pattern with HobbyPoxy. He also modified the landing gear to include a functional tail skid and made other changes to improve the Fokker's flying characteristics.

LIGHTER SCHWEIZER

Peter Riddle of Kentville, Nova Scotia, Canada, scratch-built this Schweizer 1-30 from *Model Airplane News* plans. He adapted the 72-ounce model for electric flight by cutting out lightening holes in the wing ribs, ailerons and fuselage (which he built using 1/16-inch plywood bonded to 1/8-inch balsa), and he substituted music wire in place of aluminum for the landing gear. The model has a Fiberglass Specialties cowl, and it flies well powered by a Graupner motor with a 6:1 gearbox.

HEAVY METAL

Dan Basovitch of Staten Island, NY, built this 101-inch-span AT-6 out of a Chuck Gill kit. The 28-pound plane is powered by a G-62, and it has a scale exhaust system, full interior details, navigation lights and a high-power strobe-light system. Dan covered most of the model with Ceconite and panels of chrome MonoKote cowl to simulate panels; he covered the canopy and cowl with aluminum and polished them using rouge and a buffer.

READY FOR A SORTIE

This P-40E was built by Charles Koustenis of Chantilly, VA, from a Top Flite kit. It has Robart retracts, flaps and a droppable fuel tank, and it's covered with Super Coverite and Nelson Aircraft Co. paint. An O.S. 1.20 4-stroke with a pump keeps this warbird in the air.

RUBBER CONVERSION

Charles Valentino of Lake Ronkonkoma, NY, scratch-built this 1/4-scale Boeing F4B-4 using Cleveland Models plans that originally were for the rubber-powered model in front of the Boeing's landing gear. The model, which is all-balsa with all handmade parts, has a top wingspan of 89 inches. Charles covered the F4B-4 with Super Coverite and painted it with Krylon spray paint; all the markings are hand painted. The full-size subject plane flew off the *U.S.S. Lexington* and was piloted by a Wing Commander, as evidenced by the solid blue cowl and the blue bar behind the cockpit.

Simple PROGRAMMING

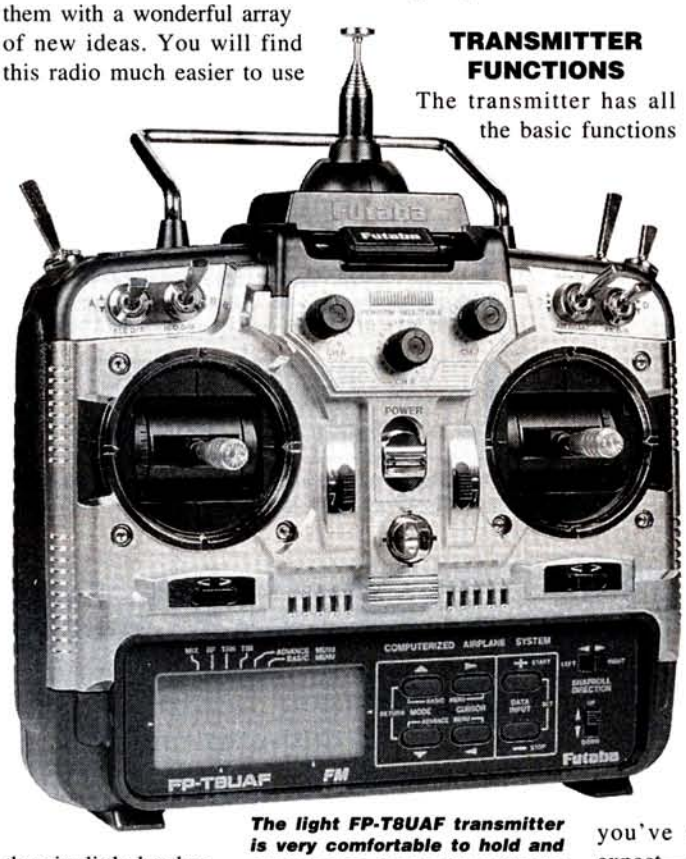
by DAVID C. BARON

FUTABA FP-T8UAF

IF YOU'VE BEEN patiently waiting for something new to arrive in the programmable radio market, your wait is over. The Futaba* FP-T8UAP is a new concept in radios, and it's simple to use and comprehend. Futaba took all the great features of their current radios and blended them with a wonderful array of new ideas. You will find this radio much easier to use than its little brother, the 7UAPS, and it's certainly a tremendous leap forward for Futaba.

TRANSMITTER FUNCTIONS

The transmitter has all the basic functions you've come to expect—adjustable travel volumes, dual rates, exponential, reversing and resets. In the new programming system, you'll find all these basic commands together. This is because they are common to the three types of models—acros, gliders and helicopters. The more complex functions are in a secondary menu that is specific to the type of model you fly—airplane, glider or helicopter. These more specialized functions show the radio's great scope and capability.



The light FP-T8UAF transmitter is very comfortable to hold and easy to use. Its design puts the sticks, knobs for channels 5 through 8 and all dual-rate and programmable-mix switches at your fingertips. The digital trims are also a great feature.

NEW MANUAL FORMAT

The manual will probably set a new industry standard for being comprehensive and easy to understand. It is not an awkward translation, but rather a superb production by Futaba USA. It includes step-by-step instructions, detailed explanations of how the different functions can be used and complete setups for airplanes, helicopters and gliders. It even has a glossary of every message and abbreviation that can be found in the display. My hat is off to Futaba's Steve Helms and especially Don Edberg for doing such a great job with it.

This radio's digital trims were inherited from the 9ZAP. The greatest value of the digital trims is that they automatically store any trim position as you switch to other model memories. With traditional trims, you must always remember to use your trim memory function, but this only pays off if you vigilantly center your trims when you switch to another model.

The hardest thing to get used to with digital trims is not being able to manipulate the throttle trim when starting or shutting down your engine. But with this radio, this is not a problem, because there's a function called "throttle cut," which kills the engine

SPECIFICATIONS

Radio: FP-T8UAP, PCM1024/T8UAF—available on 50 or 72MHz

Manufacturer: Futaba

Type: acro, heli and glider

Transmitter: 8-channel, 8-memory dual-stick transmitter with CAMpac-expandable 8-model memory module

Receiver: Slimline R148DP-PCM1024 w/T8UAP and R148DF w/T8UAF

Servos: 4, S3001 ball bearing w/T8UAP and 4, S148s w/T8UAF

Accessories: 500mAh battery pack, switch harness, aileron extension, wall-charging plug, servo-mounting trays and hardware and a frequency flag

Weight of airborne unit: T8UAP—10.6 oz.

Prices: T8UAP—$949.95; T8UAF—$799.95

Features: programmable stick and selected switch position and throttle function reverse; throttle exponential, throttle delay, throttle needle valve, V-tail and idle down (exclusive to the acro mode); light, ergonomically designed transmitter; and the case in which the radio components are packaged doubles as a transmitter carrying case.

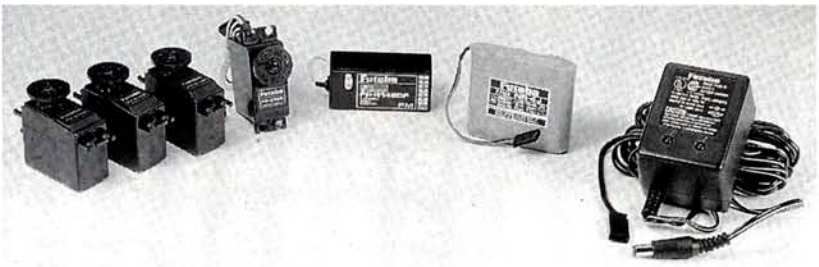
Comments: I really liked the digital trims and throttle needle mixing feature with its five-point curve. The "throttle cut" function is a great safety feature for stopping the engine. The alphanumeric model memory helps you locate the models in the transmitter faster, and the CAMpac adds eight model memory setups to your transmitter. The manual layout is state-of-the-art and easy to follow.

Hits

- Digital trims.
- Variety of the built-in mixes.
- Features and power of the programmable mixes.
- Superb manual.

Misses

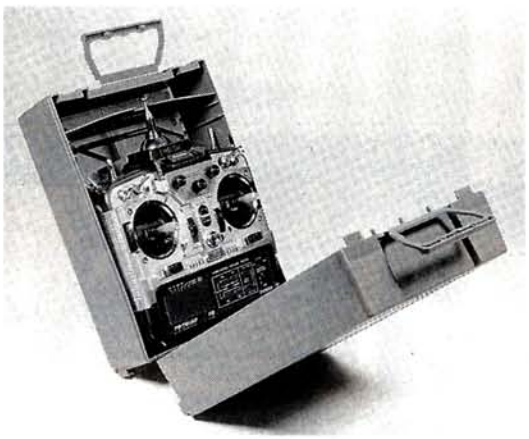
- Some of the characters in the display are too small.



Besides what you see here, you get a switch harness, a bag of mounting hardware, a frequency flag and a well-written manual.

using any switch you want. If you accidentally depress the switch, this feature safeguards against killing the engine, because you also program the throttle-stick position that dictates at which point the switch is activated.

The new feature that really impresses me is "throttle needle mixing"—mixture control that can be slaved to the throttle stick. The mixture can also be manipulated by the CH8 control knob in flight. I wish I had this on an old 4-stroke .90 that I used to own. When it was set meticulously, it idled well and ran at full throttle just fine, but the midrange was so rich that if you stayed at half throttle too long, the engine would be flooded and quit. This new function works on a five-point curve that will allow me to tailor the radio to automatically lean the engine to perfection as it approaches the midrange, then richen the mixture to the best possible settings again as the throttle moves above or below the midrange. I know this problem is very common in helicopters because they spend most of their flight time around the midrange throttle settings.



The radio components case doubles as a transmitter case. This clever packaging cuts down on excessive use of Styrofoam—a non-biodegradable product.

MIXING FUNCTIONS

The open programmable mixing functions (five total) are very well thought out. Each function has (1) linking capability, (2) offsets and (3) trim setting.

1. Linking is the capability to add a mix to another mix that is already active. As stated in the manual, a hypothetical application would be to add rudder-to-aileron mixing to a setup that already has the flaperon function activated. One use for this would be to make knife-edge maneuvers easier and smoother. If you did not have linking, your rudder-to-aileron mixing would drive only channel 1 (the right aileron). In flaperons, the left aileron is plugged into the flap channel (6), and linking directs the mix to interact with both aileron channels.

2. Offsets allow one channel to become affected by another channel with regard to stick position. For example, if you had spoilers (speed brakes) mixed into your flaperons, they would be activated by your throttle stick in very low throttle ranges. Without using the offsets to create the activation point, the spoilers would begin to rise as the throttle goes through the midpoint of stick travel.

3. Trim setting is the capability of the master channel stick and trim to affect the slave channel. In a plane that has two servos for the elevator (one for each half as commonly seen on large models), if you were to use a Y-harness, the installation would have to be perfect for the throws to end up identical on each half. It is easier and faster to plug each servo into a different port in the receiver and use programmable mixing; you have separate controls for each of the servo throws and direction, but they're driven by the same "stick." For the elevator trim to affect both channels, the trim setting switch must be activated while you program the mix.

The programming display of the FP-T8UAF.

Like the ZAP, this radio can use the CAMpac plug-in memory module. This greatly expands the transmitter memory with up to eight additional model memories and allows you to exchange model setups with other T8UA transmitters. All the model memories can now be stored alphabetically in the transmitter. With the old system on the 7UAPS system, I always thought it a nuisance to remember which number was assigned to which of my planes.

There are plenty of features still to be addressed, so I will present the helicopter and glider features in future columns. Futaba has a great new product that is extremely easy to use and worth checking out. Happy landings!

** Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

MODEL TECH P-51 MUSTANG

A great ARC warbird for Sunday sorties

by GERRY YARRISH

ALMOST EVERYONE in R/C modeling at one time or another has dreamed of the day when he can fire up a super-detailed, brightly colored Mustang, whether it's a B, D or unlimited-racer version. What could be better than building and flying a Mustang? How about an almost-ready-to-cover (ARC) version! Want more? How about an ARC version that includes flaps and a retract-ready wing? Yeah, now we're talking!

The Model Tech Mustang lends itself nicely to dozens of attractive paint schemes. I duplicated the aircraft markings of Lt. Col. Ernest Beverly's Mustang "00" when he commanded the 319th Fighter Squadron, 325th Fighter Group at Lesina, Italy, in 1944. All 325th FG aircraft wore the distinctive yellow-and-black checkerboard tail markings and had red nose markings.

When I first saw Model Tech's* Mustang ad, the plane's nose didn't look right to me. But now the model comes with a redesigned nose section for a 4-inch spinner. Its fuselage is straight, strong and very light. Few wooden blocks are used, and the inner lite-ply doublers have large cutouts. The result is reduced weight, without compromising strength. The tail feathers are built and fully sheeted (with the exception of the rudder, which must be covered with film), and the open-bay wing comes in two halves. Ailerons and flaps are built and sheeted and are ready to hinge into place. After a little sanding, the model is ready to assemble and cover.

SPECIFICATIONS

Model name: P-51D Mustang

Manufacturer: Model Tech (distributed by Global Models)

Type: almost-ready-to-cover sport scale

Wingspan: 66 in.

Airfoil: semisymmetrical

Length: 55 in.

Weight: 10 lb., 2 oz.

Wing area: 644 sq. in.

Wing loading: 36.22 oz./sq. ft.

No. of channels req'd: 5 or 6 (throttle, elevator, rudder, ailerons, flaps and optional retracts)

Radio used: JR PCM10SX

Engine req'd: .60 to .90 2-stroke

Engine used: Magnum .91

List price: $340

Features: the Model Tech P-51D Mustang is a factory-built (ARC), all-wooden model with built-up (airfoil-shaped) tail surfaces and open-bay construction for the wing. Ailerons, flaps and tail surfaces come completely built and ready to be hinged into place. Hardware, wheels, hinges, pushrods, formed canopy, dummy exhaust stacks, cowl, vacuum-formed wing fillets and instruction manual are included.

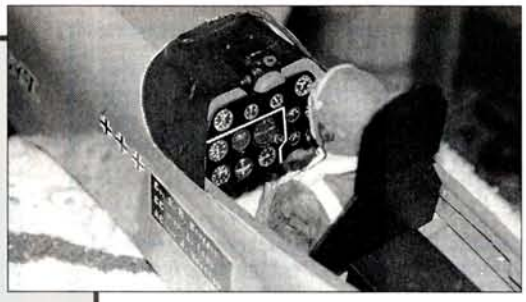
Comments: I was very pleased with the quality and workmanship evident in the construction of this model. I used Century Jet Models' retracts and installed separate servos for each of the ailerons and flaps. I used Robart* Hingepoint hinges, and I replaced the stock tail wheel with a Du-Bro tail-wheel unit.

Hits

- Good construction and workmanship.
- Wing is ready for retract installation.
- Vacuum-formed wing fillets.

Misses

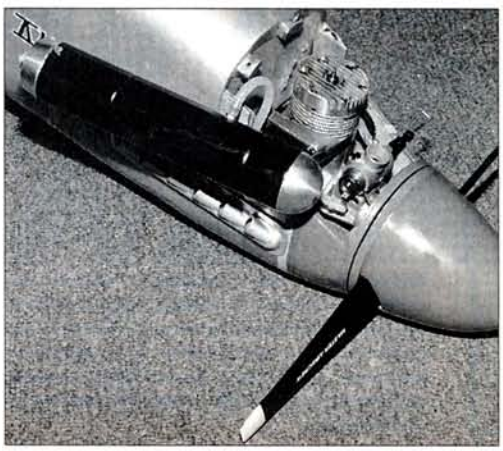
- Engine mounts needed to be shimmed with 1/16-inch-plywood for proper engine placement.
- Control-horn screws in hardware package were too short to use for the control surfaces.



The Model Tech Mustang lends itself nicely to added details, such as a tricked-out cockpit. I added a detailed instrument panel, a gun sight, a Hangar 9 pilot bust and a headrest.*

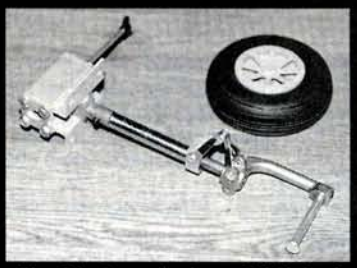
• **Power.** I used a Magnum* .91 2-stroke ABC glow engine to power the Mustang. When coupled with a 14x6 Dynathrust* prop, this engine produces more than enough power for the model. The engine needs to be shimmed up from the mount rails with thin plywood strips to place the spinner in the proper location relative to the plywood spinner plate. I then removed the engine and fuelproofed the compartment with HobbyPoxy* finishing resin. To keep the Magnum within noise limits for my flying field, I installed a Davis Model Products* muffler.

• **Fuselage**. Hardwood engine-mount beams come installed, as do the two wing hold-down blocks; the tail itself requires little work to install. The stabilizer fits so well that it slides easily it into place. Use thin CA (I used HobbyPoxy 30-minute epoxy) to glue it into place. The vertical fin and dorsal fin are also simply glued into place after you've aligned them with the fuse's centerline. It's easier to cover the stab and fin before gluing them into place.



A Magnum .91 2-stroke glow engine fits easily into the engine compartment. To make the engine and spinner align properly with the front plate, I had to shim the engine up with 1/16-inch-thick strips of plywood glued to the engine-mount rails. The Davis Model Products muffler effectively quiets the mighty .91.

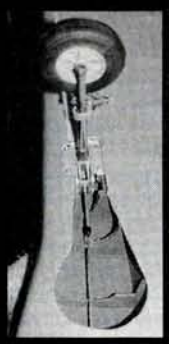
Pulling Up the Wheels



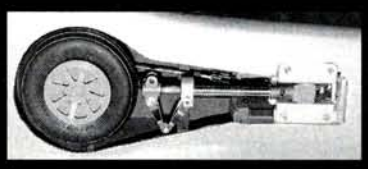
The Mustang just wouldn't look right with fixed gear hanging down from the wing. I chose Century Jet Models' mechanical retracts and Robart 3-inch- diameter scale wheels for the model to stand on.

The instructions show how to install the hardwood mount blocks—included in the package—for fixed landing gear. I chose to install Century Jet Models*' mechanical retracts and found that they fit with only a minor amount of work. To make the retracts fit, I had to remove some material from the hardwood gear-mount rails with a wood chisel. To tilt the gear forward and place the wheel axles in a more favorable position, you should add 1/8-inch-thick plywood strips to the aft mount rails.

I used a JR NES-703 retract servo and solid, 2-56 wire pushrods to connect the gear to the servo. I secured the retracts in place with Du-Bro* 4/40 cap-head self-tapping screws.



To place the wheel axles in a better position glue an 1/8-inch-thick strip of plywood on top of the aft gear-mount rails. This tilts the retracts (in the down position) forward for better ground handling.



Here, the completed retract system has been installed in the wing. I painted the inside of the wheel well with fuelproof zinc-chromate-colored paint for a finished look. The only thing I didn't like about the wing's design is that the retract mount rails don't allow the retracts to sit deeply enough in the wing for scale gear doors to be used. Because this is an ARC sport-scale model, it isn't considered a problem.

FLIGHT PERFORMANCE

Editor's note: because of harsh winter weather in Connecticut when this article was being written, we sent the review model to our Florida-based contributor, Rich Uravitch, for flight evaluation.

• Ground handling

If you balance your Mustang at the point recommended by the manufacturer (3½ inches back from the leading edge of the wing at the center section) you will probably find that the model tends to tip over on its nose when attempting to taxi. Steering then becomes a chore, because there isn't enough elevator power to plant the tail wheel firmly on the runway. The CG location just didn't look right to me when I set up the model and checked the control throws and balance in both the pitch and roll axes. A quick computation indicated that the specified CG could safely be moved aft ¾ inch, which put its final location at 4¼ inches back from the leading edge. This is still conservative; you'll be able to go even farther aft if your brand of flying calls for it. After this change, the Mustang performed much better on the ground—a real benefit to any tail-dragger.

• Takeoff

Nothing really unusual here. I expected much more of a tendency to swing left when power was applied. I was pleasantly surprised that the Mustang, after gradual application of power, tracked straight down the strip, almost in tricycle-gear fashion! The tail came up in about 10 feet, and the 51 ran on the mains for about 75 feet before lifting off cleanly, beginning a straight, gradual climb-out.

• High-speed performance

After a few circuits to adjust the trim, which consisted of some right aileron and down elevator, I brought the Mustang down on the deck for a few high-speed passes. The Magnum .91 quietly hauled the airframe around at what could be considered "scale-like" speed—at something around ¾ throttle! I have every confidence that this model, especially film-covered as this one was, could easily fly well with any of the healthier .61 engines available today. On these passes, none of the onlookers doubted that this was all Mustang! All that was missing was the unmistakable sound of the Merlin engine and the ever-vigilant Rock Hudson, searching for Yaks over Korea while "Battle Hymn of the Republic" played in the background.

• Low-speed performance

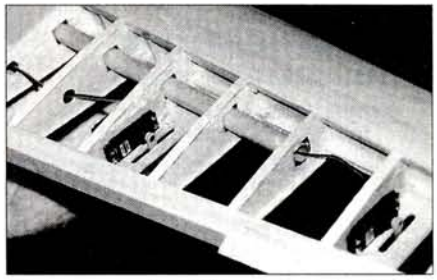
When I slowed the model down to approach speed (at altitude), it displayed a tendency to stall to the left ever so gently. At slightly above idle-power setting, however, the Mustang could be made to hang, nose high, while it maintained forward slow flight. The ailerons got mushy, as did the rudder, but the elevator continued to work nicely. This phase of the testing was performed gear and flaps up.

• Aerobatics

When the control throws were set up according to the instructions, the ailerons seemed a little slow. Some of their effectiveness could be recovered by sealing the hinge gap a little better. Slow rolls were graceful; they required gentle elevator inputs during the last half of the maneuver. The split-S's really looked great, especially when concluded at about 20 feet of altitude, full bore. The model got surprisingly draggy in the vertical; at straight and level with the Magnum, it was outstanding, but a lot of energy was lost when it started going straight up! It won't climb out of sight, but who cares? Big loops were easy. Spins weren't attempted but, if entered, even accidentally, recovery shouldn't be a problem because of the Mustang's gentle stall characteristics. Knife-edge, although decidedly un-scale-like for a Mustang, wasn't that bad—probably a result of the generous side area of the fuselage. Overall, the model turned in a better-than-expected performance during the aerobatic portion of the flight.

• Approach and landing

Approaches and landings were performed in both full-flap and zero-flap configurations. Without the flaps deployed, the landing speed was faster with a lower power setting. Control the sink rate with the throttle, and the Mustang will perform some of the prettiest wheel landings that you've seen in a long time. On touchdown, however, remember that the model is still moving fairly quickly, so maintain directional control with the rudder until the tail is on the ground and tail-wheel steering becomes the means of driving it around. Full-flap landings also looked great. I usually extend the gear on the downwind leg and gradually start feeding in flap on the base leg, so they are fully extended as I turn onto final. It will take quite a bit more throttle to maintain the required sink rate, but you'll touch down more slowly and probably not nearly as far down the runway. When the airplane stops on the runway, retract the flaps (not the gear!) and taxi back, applying up-elevator to keep the tail down.

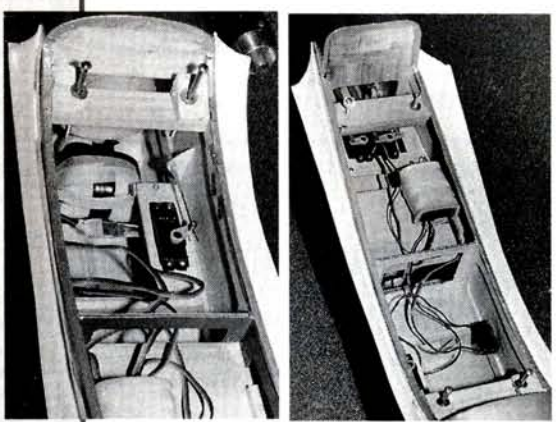


Here you see the right wing panel with the flap and aileron servos screwed into place on plywood plates attached to the ribs. To do this, you must also install cardboard tubes in the wing to route the servo wires.

• **Wings.** The wing halves must be joined together and reinforced with a thick, hardwood, dihedral brace/joiner. I wrapped the center sections with 6-ounce fiberglass cloth applied with Balsa USA's* thin CA. The instruction booklet shows how to install the flap torque-rod hardware and aileron pushrods and bellcranks. I chose to install a separate servo for each aileron and flap, and this required the installation of cardboard tubes to route the servo wires. I used tubes from The Aeroplane Works*; they slid into place through the square holes already cut in the ribs. I had to cut a few additional holes in the ribs for the flap servo wires; I then installed the retracts and retract servo.

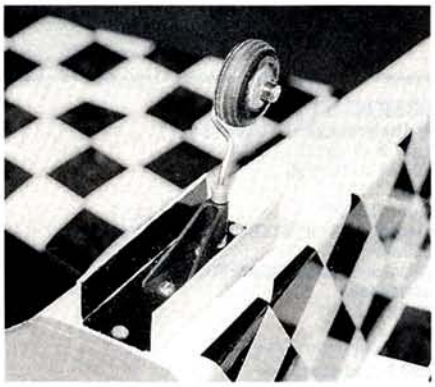
• **Cover and Finish**

I used Coverite* 21st Century film, vinyl stick-on graphics and spray paint. The paint was applied to the engine cowl, wing fairings and canopy. To make the nose art, squadron numbers and checkerboards, as well as smaller details such as gas caps, gill vent covers and wing stripes, I used a Stika* vinyl-cutting machine loaded with



Inside, the model has plenty of room for the radio, even with the cockpit floor protuding into the lower fuselage area. Above left, the throttle servo and battery sit behind the fuel tank. Above right, the receiver, elevator and rudder servos sit in the aft section of the fuselage.

Coverite graphics material. The U.S. insignias come from Major Decals*. With all the airframe parts covered and the wing attached to the fuselage, I next added the vacuum-formed wing fillets. I cut them out with my band saw and lightly sanded them before painting them silver. IMP* PFM adhesive is excellent for gluing the plastic fillets into place.



For convenience, I made my tail-wheel unit removable by screwing a Du-Bro tail wheel bracket to a plywood plate and screwing the plate to the model as shown. The plate is removable, so it's easy to adjust and maintain the tail wheel.

• Radio

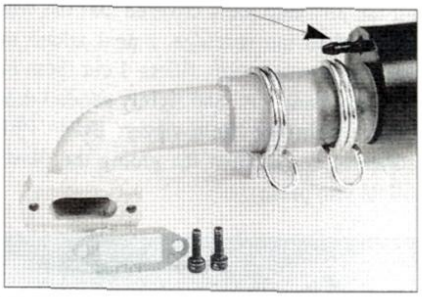
I used a JR* PCM-10SX radio, and JR NES-531 servos for control. The 10SX radio, with its touch-screen adjustments, makes initial control setup and flight adjustments very easy. I used Dave Brown* fiberglass pushrods for rudder and elevator control, and a separate wooden dowel pushrod for tail-wheel steering. To shorten the length of the pushrods, I installed the servos in the aft section of the radio compartment.

ON THE TARMAC

Ground handling is good, but you should have some previous tail-dragging experience. In Mustangs, the tail wheel is placed just aft of the belly scoop, which makes the model's landing gear a bit short-coupled. Rudder control is very important here, as is a little "toe-in" on the main wheels for good ground handling. Once you get the feel for the model, you won't have any trouble. With the engine purring and the flaps cracked a notch, and a final wiggle of the controls, suddenly it's Lesina, Italy, 1944, or Taegu, Korea, 1952, or Reno, NV, 1970. Take your pick!

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

by DAVE GIERKE



Tuned silencer with header pipe, silicone connector tubing, clamps, gasket and machine screws. Note the pressure fitting.

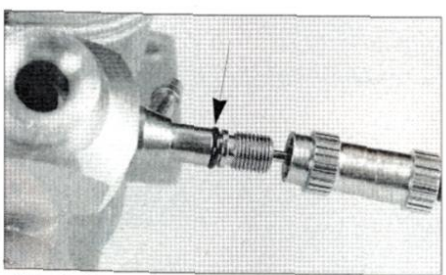
MVVS GFS/R .40

IN THE LATE 1950s, while my high school buddies were excited by rock stars and athletes, most of my heroes were designers, builders and fliers of model airplanes. By reading *Model Airplane News, Flying Models* and *American Modeler,* I was able to follow the exploits of Bob Palmer in stunt, Riley Wooten in combat, and Bill Wisniewski in speed. In those days, control-line and free flight were king-of-the-hill, while the infant radio-control industry struggled to provide reliable, affordable equipment.

The MVVS GFS/R .40 engine with tuned silencer.

American champions shared something in common: they used American-manufactured engines. Fox, Dooling, Johnson, K&B, McCoy and Veco dominated the large glow-engine events. As a teenager, I could rattle off the size and advertised horsepower for every American engine. It wasn't that difficult; there were only about three dozen engines made. Today, more than *500 different engines* are available from all over the world. If this statistic sounds outrageous, use the advertisements in this magazine and start counting them for yourself.

I first read about the Czechoslovakian MVVS engine (translated: Modeler's Development and Research Center) in *Model Airplane News* back in 1957 or '58. For the fun of it, I checked through my back issues; sure enough, there were several brief stories in Peter Chinn's "Foreign Notes" column concerning some eye-opening performances. An MVVS .35, sleeved down to .30ci, allegedly established a new FAI world record of 151.6mph using alcohol-and-castor-oil fuel. Photos of the engine revealed that its exterior resembled a McCoy crankcase with a Dooling bulge bypass; its interior displayed strong Dooling influences, including a plastic rotary-disk induction valve and a ringed aluminum-alloy piston. At the time, the Czech claimed a very high 0.75b.hp at 15,000rpm (*Model Airplane News*, April 1958). The



The O-ring seals between the needle valve and the needle valve body prevent air leaks.

SPECIFICATIONS

Cylinder displacement: 0.402ci/6.58cc
Bore: 0.827 in./21.0mm
Stroke: 0.748 in./19.0mm
Bore/stroke: 1.12/1
Stroke/bore: 0.895/1
Conrod length: 1.341 in./34.06mm (center to center)
Conrod/stroke: 1.8/1
Combustion-chamber volume @ TDC: 0.66cc
Compression ratio
—geometric: 10.98/1
—effective: 7.49/1
Carburetor bore: 0.279 in./7.09mm
Crankshaft thread size: 6mm
Weight (bare): 13.28 oz./376.5gm
—w/muffler: 18 oz./510.5gm
Cylinder taper (TDC to BDC): 0.001 in.
Cylinder taper (BDC to bottom of sleeve): 0.002 in.

PERFORMANCE

Maximum torque: 92 oz.-in. @ 13,100 rpm
Maximum b.hp: 1.35 @ 16,900rpm
B.hp/ci: 3.36
B.hp/lb.: 1.2
Oz.-in./ci: 228.9
Oz.-in./lb.: 81.8

NOISE LEVEL

Muffler/tuned pipe: 98dBA @ 15,500
Fuel: 15% nitro; 20% lube
Propeller: 10x5 APC
Sound meter: Radio Shack no. 33-2050
Meter setting: "A" scale; slow response
Distance from engine: 9 feet

PORT AND INLET TIMING

Exhaust
—opens: 80° BBDC
—closes: 80° ABDC
Total open: 160°

BOOST AND TRANSFERS

—opens: 60° BBDC
—closes: 60° ABDC
Total open: 120°

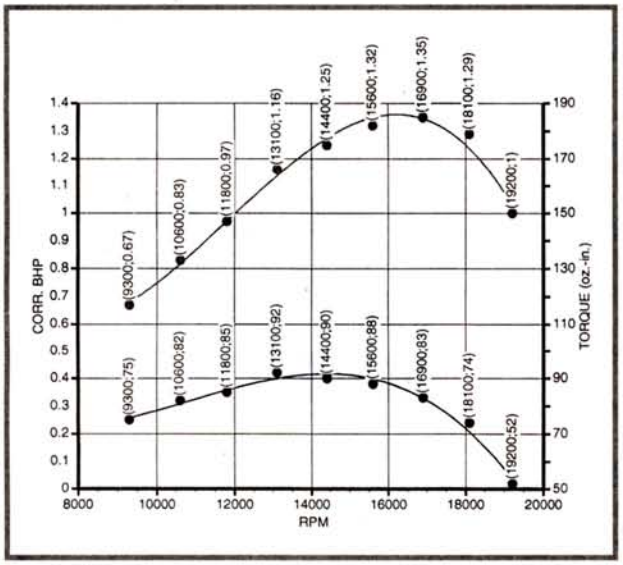
Inlet (induction)
—opens: 36° ABDC
—closes: 38° ATDC
Total open: 182°

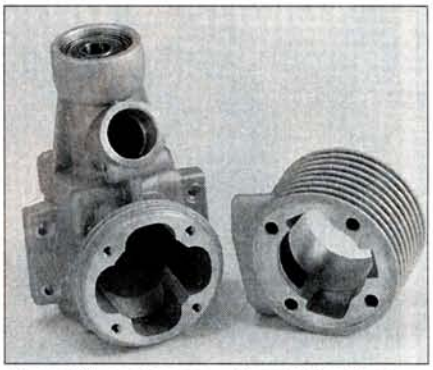
Comments: despite a couple of minor problems, I found the MVVS GSF/R .40 to be an easy-to-start, smooth runner with a low idle and a good transition from low to high throttle.

LIST PRICE: $117

Features: a glow ignition (G), front intake (F), side exhaust (S), 6.5cc (.40ci) R/C engine that features: Schnuerle porting with a boost-port scavenging system; a rotation feature (R) that allows the upper case to be rotated; true ABC piston and cylinder technology; an exhaust silencer (MM-S) that includes a header pipe; silicone connector tubing, clamps, gasket and capscrews; two-year warrantee policy.

Editor's note: if rapid throttle response is what you need, at least one manufacturer of lightweight, profile airplanes noted for their ability to hover and perform aerobatics at very low altitude recommends the MVVS for these planes. This recommendation is based on that manufacturer's finding that the engine has both rapid and linear throttle response. Dave Gierke's report confirms the engine's rapid throttle response.



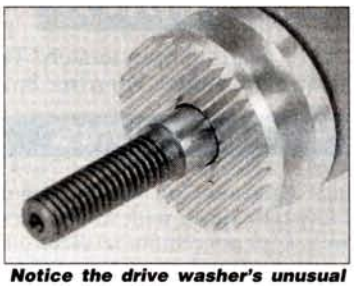


The split crankcase with rotation feature. Notice the four bypass passageways in the lower section; only three can be used for any position of the upper case; the fourth goes beneath the exhaust port where problems can occur.

MVVS 2.5cc (.15ci) FAI speed engine was also a powerhouse, winning several European contests, including the world championships. Peter stated, "The motor can best be described as resembling a miniature Dooling." (*Model Airplane News,* February 1960). In 1958, Czechoslovakia's Josef Gabris won the International Stunt Championship; he used an MVVS .35 fitted with a ringed piston, rear-rotary-disk induction and ball bearings for crankshaft support—a very unusual combination by our standards.

MVVS was sponsored by the Communist government to provide modern equipment to their countrymen for international competitions. After the recent revolution, MVVS emerged as a private firm in the free Czech Republic. Their engines are distributed in the United States by Czech Mate Distributing Inc.*

This month's review engine, the MVVS GFS/R .40 (no. 3066) is a glow ignition (G), front intake (F), side exhaust (S), 6.5cc (.40ci) R/C engine. It utilizes the popular Schnuerle with boost-port scavenging system and comes with a rotation feature (R) that will be discussed later. The GFS/R is known as the *standard 40* in the sales brochure. Other MVVS .40s include the no. 3065 GRRT for *FAI pylon racing* (alcohol fuel; no nitromethane), and the no. 3068 Q500 *racing .40.* All of these feature true ABC piston and cylinder technology (aluminum-alloy piston with brass cylinder, chrome plated). Our test engine came fitted with a no. 3248 exhaust silencer (MM-S), which included a header pipe, silicone connector tubing, clamps, gasket and capscrews.



Notice the drive washer's unusual serrated front face.

SPECIFICATIONS

With a stroke of 0.748 and a bore of 0.827, the engine's displacement calculates to .402ci (6.58cc). The stroke-to-bore ratio (0.895 to 1) compares favorably with other successful over-square, high-speed engine designs. The connecting-rod-to-stroke ratio (1.8 to 1) is average compared with many contemporary designs.

The effective compression ratio, calcu-

BVM IN-FLIGHT MIXTURE CONTROL

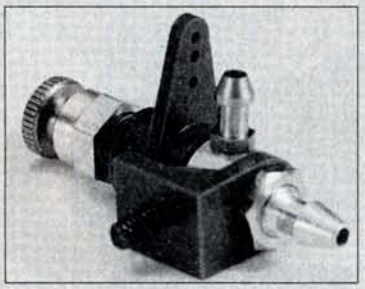
Bob Violett Models* (BVM) has produced an In-Flight Mixture Control for the power modeling community. The idea isn't new, but the engineering is first class—plus, it performs to perfection! I liked it so much that I bought the company (just kidding). Actually, I liked it so much that I've installed one on my engine testing dynamometer and another on my telemetry-equipped engine test model.

BVM sells most of their mixture-control units to boat and ducted-fan people, but anyone who flies glow-, diesel-or spark-ignition-powered model aircraft can use one (even sport modelers).

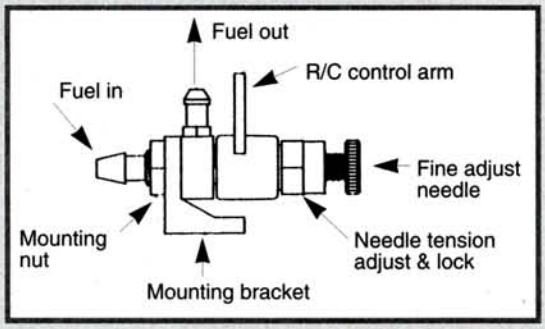
What can mixture control do for you and your engine? First, it allows you to adjust the engine's air-fuel ratio while the model is flying. If you accidentally take off "blubbering rich," simply push the mixture-control lever (on the transmitter) toward "lean." This will actuate a servo that's connected by a pushrod to the unit's control arm and instantly lean the mixture.

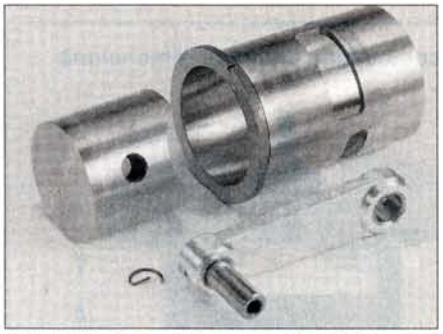
Mixture control is especially useful for richening settings that have been inadvertently set too lean. You've probably heard the sound: the engine slows at wide-open throttle; the exhaust noise has been reduced to the thunder of a sewing machine—often accompanied by a crackling "frying egg" sound. Without mixture control, you're in big trouble! Normally, the best you can do is throttle back and land. Lean settings produce unacceptably high engine temperatures that can easily damage or destroy the piston and/or cylinder liner. With mixture control, simply push the control lever toward "rich," and the engine's performance will be restored to its former glory.

There's a safety benefit associated with using this unit; your fingers are displaced from a potentially dangerous position at the engine's needle valve (near the propeller) to the relative safety of the remotely located mixture control where initial (fine

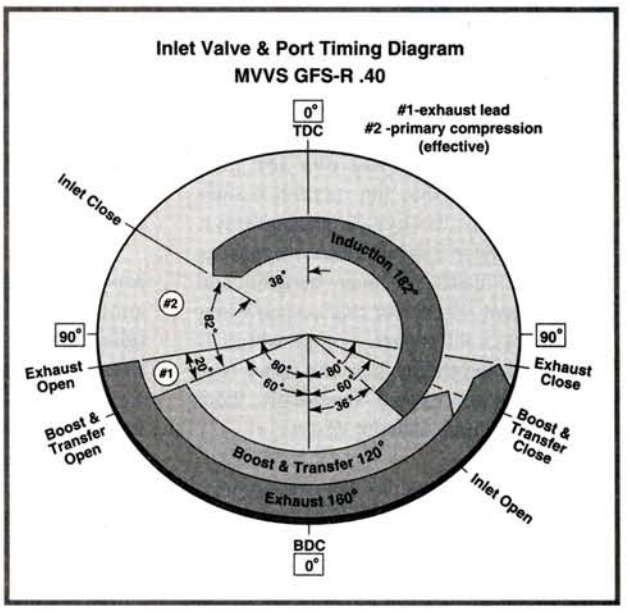


The BVM In-Flight Mixture Control is very compact—only 2 inches (overall) from fuel inlet to needle valve. Notice the mounting nut that holds the mounting bracket in place.





The high-silicon aluminum-alloy piston and the brass/chrome-plated cylinder sleeve. Note the double-bushed connecting rod and the lightweight wristpin. The G-shaped wristpin retainer clip is visible in the foreground.



lated from the point of exhaust-port closure, is relatively low (7.49 to 1) compared with similar sport engines. Additional power and performance could be realized by increasing the compression, but the engine would probably lose its docile handling characteristics. The carburetor (no. 3216) choke diameter (0.279 in.) is about average for a .40 sport engine. Enlarging this bore would boost power, but the idle and mid-range transitional characteristics would undoubtedly suffer.

The engine's exhaust port is open for quite a long period (166°) especially when compared with the relatively short induction period (182°). The port-timing diagram shows the inlet closing at 38° ATDC; this is unusual. Normally, when designers plan a long exhaust period, they also allow the inlet valve to remain open longer; this anticipates that higher shaft speeds and horsepower are the goals, which isn't the case here. This engine uses the long exhaust period to help scavenge the cylinder and crankcase by using a tuned exhaust system; closing the inlet early also provides greater primary compression (crankcase), which aids the transfer of air-fuel mixture to the cylinder. Our test engine weighed 18 ounces complete with its tuned exhaust system; the header, silencer, clamps, tubing and mounting bracket weigh almost 5 ounces.

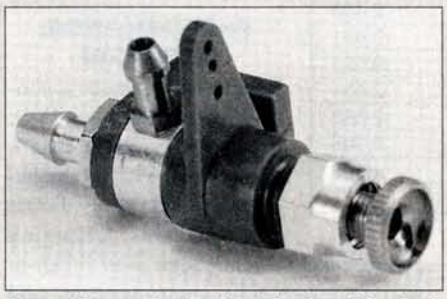
Button-head insert with finned retainer, aluminum shim and glow plug.

CONSTRUCTION

The aluminum-alloy crankcase and rear cover are cast using the permanent mold method. The two-piece aluminum cylinder head consists of a retainer ring with cooling fins and a button insert. The combustion chamber follows proven practice, having a squish band and a single hemispherical volume; it came equipped with a 0.005-inch soft-aluminum shim. The head components are clamped to the top of the crankcase by four Allen-head capscrews (3x13mm).

I was curious why the crankcase casting showed provisions for eight screws when the head was held in place by only four. After I removed the head, the mystery was solved: four, long, slotted-head machine screws (3x30mm) were holding the *upper half* of the crankcase to the *lower half*, with the separation occurring just below the exhaust port (this feature isn't apparent on a casual inspection of the engine's exterior). This idea isn't new. Designers from the spark-ignition era utilized the split case to facilitate machining the bypass passageways. The MVVS configuration reminded me of SuperTigre's first version of the X-40 racing engine from the early '70s. Tigre soon changed to a one-piece crankcase; racers claimed the split-case version didn't offer enough structural stability for high-horsepower applications.

The "R" in the GFS/R designation refers to the *rotation feature* associated with the upper portion of the case. According to MVVS literature, this feature can be found on "...select *side* exhaust MVVS .15, .21, .40, .61 and .77 engine models. All engines produced after 1994, delivered in side exhaust configuration can be rotated to rear exhaust (or the opposite side—D.G.). The



Here, the needle-tension-adjust and locknut and R/C control arm are clearly visible. This is a great unit; every serious flier should have at least one!

adjust needle) settings are performed. To ensure that the unit operates successfully, the needle valve at the carburetor must be opened completely; however, many veteran mixture-control users prefer to remove the needle from the spraybar altogether and plug the hole with solder.

The BVM In-Flight Mixture Control, by opening and closing an orifice within the unit, varies the amount of fuel that is delivered to the engine's carburetor. Violett accomplishes this by advancing or retracting the primary needle on a coarse machine-screw thread, which is part of the mixture-control body. The instructions state, "The control arm should be oriented such that it is ½ to ¾ of a turn open as a starting point. The fine adjust needle should be about 2 turns open as a starting point...connect the servo-operated linkage to the center hole in the plastic R/C control arm. The fuel mixture is leaned by rotating the arm clockwise by remote control or by turning the fine adjust needle clockwise."

The BVM In-Flight Mixture Control is made of vibration-resistant brass and has a high-impact injection-molded plastic mounting bracket and control arm. It's listed at $35 and is available at hobby stores and directly from BVM.

cylinder and liner can be rotated to the rear (only before break-in). The ports line up perfectly."

From the photo, you can see how MVVS accomplishes the rotation feature with respect to the bypass passageways. The upper case contains three bypasses located 90° apart: two main transfers and the boost port. The lower case contains four passageways 90° apart, one of which is never used, depending how the upper case and cylinder are rotated. Potentially, there could be problems with this design:

1. Because the bypass passageways are mismatched between the upper and lower sections of the crankcase, the sharp transitions (steps) create turbulent flow conditions, reducing the engine's ability to move dense air-fuel mixtures to the cylinder; in other words, its delivery ratio efficiency has been adversely affected. This problem might explain the advanced exhaust-port timing discussed earlier.

2. The unused channel in the lower case always positions itself directly below the exhaust port. This leaves only a thin band of cylinder sleeve (about 3/16 inch) below the exhaust port to seal against the case. If the seal area leaks when the piston descends in the cylinder (before the transfer ports open), pressurized air-fuel mixture will be transferred directly from the crankcase and out through the exhaust. The short-circuiting mixture is also boosted by the strong negative pressure generated from the tuned silencer. Of course, this condition is also possible with normally configured engines having much wider sealing bands, especially when *drop-in cylinders* are used. "Drop-in" refers to a light push-fit between the cylinder and the case; under normal conditions, an extra few ten-thousandths-inch clearance can lead to leakage. The GFS/R.40 also uses a drop-in cylinder. Symptoms of crankcase short-circuiting include high fuel consumption and power loss. Friend and West Coast engine guru Luke Roy suggested a simple test: place a few drops of low-viscosity oil in the bottom of the exhaust where the liner meets the case; flip the propeller briskly while watching for telltale bubbles; I did, and there were many. After doing this test on the MVVS, I subjected several other engines of conventional design to the same test and found no such problem in the process.

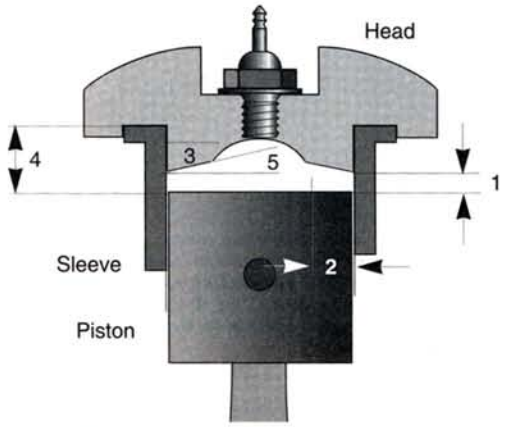
When the weather improves this spring, I'll try another of Luke's suggestions: with an open exhaust (no exhaust system) I'll direct a timed, high-intensity strobe light into the exhaust to see if the leakage can be detected as the piston descends, just before exhaust-port opening. This will be done to satisfy my curiosity.

The top flange of the cylinder sleeve has a machined notch for alignment with the case; however, this element has been rendered inoperative with the new rotation feature, which doesn't allow for a fixed pin in the top of the case.

The silicon-aluminum piston weighs 7.1 grams. The machined aluminum-alloy connecting rod is bronze-bushed and drilled for lubrication at both ends. First, the steel wristpin is blind-drilled for lightness; then it's hardened and centerless-ground to final external dimensions; the free-floating unit is retained in the piston by two G-shaped music-wire clips. The one-piece crankshaft has an open-web counterbalance and is supported by two ball bearings; the front bearing is fitted with a dust shield. Propeller-shaft threads are 6mm in diameter. The bar-stock aluminum-alloy drive washer is locked to the propeller shaft by a brass split cone.

A twin-needle carburetor of conventional design is secured to the crankcase casting by a cinch bar; a silicone rubber O-ring provides an airtight seal. The spraybar is fitted with a small O-ring that helps eliminate air leaks through the needle valve—a nice touch. A machined helical groove on the throttle-barrel body controls the air and fuel metering between idle and wide-open throttle. I noticed that the choke hole in the barrel didn't align with its counterpart in the carburetor body at the wide-open throttle—a minor but annoying problem that's common to many engines.

Head & combustion chamber dimensions



1. Head clearance .....0.026 inch
2. Squish-band width .....0.168 inch
3. Plug depth .....0.117 inch
4. Deck clearance .....0.155 inch
5. Squish-band angle .....1°

% squish-band area 33.9%
% combustion-chamber area 66.1%

RPM	TORQUE	CORR. BHP	BHP	CORR. FACTOR	DISTANCE
8,000					
9,300	75	0.67	0.69	0.97	2.160
10,600	82	0.83	0.86	0.97	2.362
11,800	85	0.97	1.00	0.97	2.430
13,100	92	1.16	1.20	0.97	2.631
14,400	90	1.25	1.29	0.97	2.583
15,600	88	1.32	1.36	0.97	2.531
16,900	83	1.35	1.39	0.97	2.383
18,100	74	1.29	1.33	0.97	2.105
19,200	52	1.00	1.03	0.97	1.500
20,000					

Wet bulb (°F)	34
Dry bulb (°F)	36
Bar. pressure (Hg)	30.2
Vapor pressure (Hg)	0.19

PERFORMANCE: BREAK-IN

Decide which exhaust configuration you want (left, right, or rear), and change it (if necessary) before break-in. Piston side loads dictate wear patterns; changing cylinder-sleeve orientation after break-in will generate *new* wear patterns and decreased performance.

For break-in, MVVS recommends the following: "The engines are...always run in without the model. The flight air-screw and FAI fuel (80 percent methyl alcohol and 20 percent castor oil) are used for running in an engine with a spark plug.... The engine is set for medium revolutions with a richer fuel mix. After 15 minutes of running, tune the engine for top speed. If it will run for one minute without losing revolutions, then the running-in period is finished. If the revolutions drop, the procedure must be repeated."

To avoid premature wear, I always use specific break-in techniques for ABC-type engines. Although we've thoroughly discussed these procedures in previous "RPM" columns, they should be reviewed from time to time:

• **Bench-running for break-in.** All engines should be broken in (run in) on a test stand; the operator can control the air-fuel mixture *instantly* by adjusting the primary needle valve. The problem with running in an engine in flight is that it's difficult to determine when it's running lean and hot. Even when you throttle back, the mixture may still be lean. Severe damage can and will occur by prolonged lean or under-cooled operation. Save yourself the grief and expense; run your ABC engine on the test stand for a minimum of 45 minutes, 2 to 3 minutes at a time, with adequate cooling periods between runs.

• **Two-cycle vs. 4-cycle operation.** It's important to operate an ABC engine *2-cycling* during break-in. Don't allow the engine to *4-cycle*. For certain types of piston/cylinder-sleeve combinations, i.e., iron piston/steel sleeve; this is preferred, but *not* ABCs! If you operate your ABC 4-cycling, it will run exceptionally cool because the engine is only firing every other revolution, and the overly rich mixture is cooling the piston/sleeve. This cool condition allows the piston to rub excessively because the sleeve doesn't expand enough to fully overcome the cold interference fit. The last thing you want to do is lose the tight piston fit at top dead center (TDC).

• **Setting the needle valve.** Finally, don't try to peak the needle for maximum rpm until the last 15 minutes of your 45-minute break-in period. The engine should be operated at a rich 2-cycling level—occasionally leaning for a few seconds—then richen. Be sure to use a break-in propeller that is about 1 inch less in diameter than the recommended flying prop. You don't want to overload (overwork) the engine during this critical phase. I keep a log of the break-in procedure, including run time, rpm and any special notes for each engine.

PERFORMANCE: DYNAMOMETER TESTING

After break-in, the engine was fitted with MVVS's standard expansion chamber silencer (no. 3245) and mounted on the dyno; the actual running and data acquisition was straightforward, with no unusual operational circumstances. Nice torque and horsepower curves resulted, with peaks of 85 oz.-in. at 11,800rpm and 1.22b.hp at 16,900rpm. Next, I tried the tuned silencer (no. 3248) that was supplied with the engine (see the included chart and graph). The new combination produced a pronounced increase in torque and horsepower, starting about 13,000rpm. The new peaks were 92 oz.-in. at 13,100rpm, and 1.35b.hp at 16,900rpm; these represented a 10-percent increase over the stock silencer. Both produced identical sound pressure levels of 98dBA.

CONCLUSIONS

MVVS's motto is, "The quality you expect from a handmade product." My evaluation engine contained several cosmetic blemishes and a few oversights that can only be attributed to the factory. Ding marks were noted on the header pipe and a fin on the upper crankcase casting; the drive washer and split brass cone bore the unmistakable signs of having been grasped by pliers; the piston was scratched near one wristpin hole where the assembler apparently slipped when installing the retainer clip.

An internal inspection revealed metal filings in the crankshaft passageway. After removing the crank, I discovered metal flashing at the bottom of the machined venturi area of the case; it was removed with a sharp no. 11 X-Acto blade. Unfortunately for me, a tiny piece of flashing got into the rear ball bearing, necessitating its removal from the crankcase for ultrasonic cleaning. There was also aluminum flashing at the bottom of all four bypass passageways of the lower crankcase.

With all of the minor problems and concerns taken into consideration, the "Standard .40" is an easy starting, smooth running engine that produces adequate torque and horsepower for all sport-model applications. Throttle response is excellent, with a reliable 2,600rpm idle.

Warranty policy: all MVVS engines, except the GRR, GRRT and Quickie 500 .40, are warranted against workmanship and manufacturing defects for two years from the date of purchase. The GRR, GRRT and Q500 .40 are strictly racing engines and have no warranty. The engine is advertised to sell for about $117 (not including tuned silencer). Czech Mate Distributing Inc. supplies instructions, a parts list and exploded view of the engine, an illustrated color brochure and a three-page story, "MVVS: 40 Unbelievable Years."

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

PSEUDO SCALE

An idea that combines craftmanship and originality

by RUPERT KOSMALA WITH ILLUSTRATIONS BY JIM NEWMAN

ACCORDING TO Webster's dictionary definition of the word "model"—a miniature representation of an object—the word "scale" in the term "scale model" is a misuse of the word. A model airplane that isn't a miniature copy of a full-size airplane is an airplane in its own right and is not a model of anything. Fortunately, we all know what we mean when we say "model airplanes" and "scale models" and nobody is confused by these terms, but there is a significant difference between an original design and a miniature copy of a full-size aircraft.

CRAFTSMANSHIP

Watching a scale model—especially a large one—fly has a strong effect on most people. It stirs the emotions and the imagination in a curious way and evokes nostalgia for past experiences. Maybe it simply appeals to the child in all of us.

For the modeler who likes vintage or WW 1 models, the Proctor* Antic series is a non scale approach to early aviation design. Shown here is the Antic Bipe. Others in the series are the Antic and the Mini Antic monoplanes.

The ultimate in utility/bush-plane design? Jim's design uses steel-tube fuselage construction; the wing has a composite spar with wooden ribs and fabric covering; and it has a steel-tube tail boom and a composite tail group. The rear portion of the fuselage swings aside for cargo loading, and the cockpit windows swing up to allow easy entry. Large flaps, mini ailerons and spoilerons are used for wing controls. The kneeling landing gear lowers the fuselage to allow awkward cargo to be loaded.

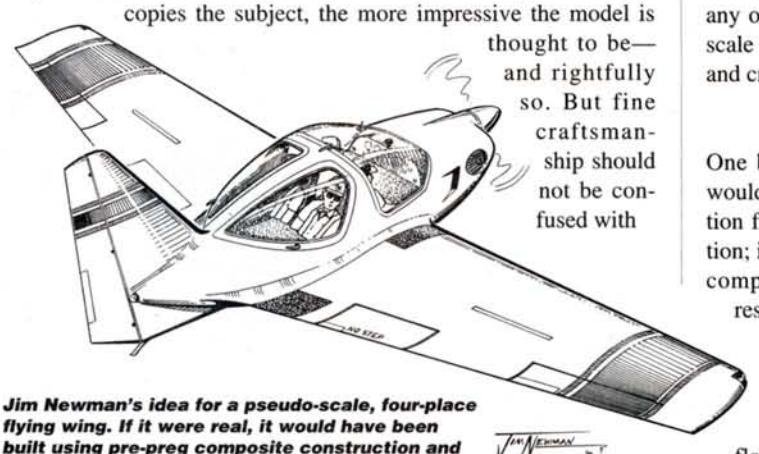
Many consider scale modeling the "peak" of the hobby. A fine scale model generates considerable awe and respect. The builder who invests time in crafting a masterpiece earns the admiration of his peers and a deserved boost to his ego.

Paradoxically, the models we admire most are those that show the least creativity with respect to design, because they replicate the originals most accurately. The more meticulously the builder copies the subject, the more impressive the model is thought to be—and rightfully so. But fine craftsmanship should not be confused with originality in design.

When building a scale model, there is zero opportunity to exercise originality in design aspects that affect its performance. The serious scale modeler accepts the design he has chosen to copy, warts and all. Sometimes the warts show up during flight, because the more accurate the model, the more accurately it mimics the flying characteristics of the original. Sometimes those characteristics put the superb craftsmanship at great risk because the model is difficult to fly.

It seems to me there's room for another classification of model that combines an appraisal of both craftsmanship and originality of design. This new class of model could be called "pseudo scale."

In this class, every airplane would be a totally original design that would comprise different aspects of full-size planes. Whereas a scale model scores higher the more accurately it replicates an original, a pseudo-scale plane would score lower the more closely it resembles a full-size plane. Yet realism would earn high points; full-size-like design characteristics and detailing would be good, but if those details resemble a particular full-size plane, that would not be good. Combining features from different planes and making them work together on a pseudo-scale plane would be creative. The result might look like bits of lots of planes but would not resemble any one in particular. Such a plane would have all the appeal of a scale model, and it would be a product of the builder's imagination and creativity.

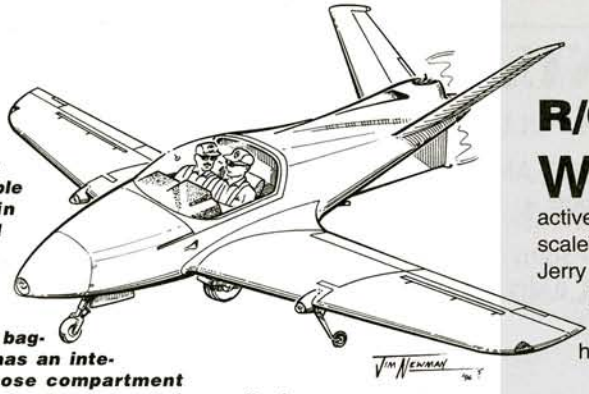


Jim Newman's idea for a pseudo-scale, four-place flying wing. If it were real, it would have been built using pre-preg composite construction and would be powered by a water-cooled engine. The back-to-back seating saves space, and spoilers control glide path and descent.

PSEUDO-SCALE DOCUMENTATION

One big difference between the scale and pseudo-scale classes would be the documentation. Some modelers derive great satisfaction from the research that goes into assembling scale documentation; it's called "historical research," and it's a prerequisite to being competitive in scale modeling. Some modelers feel that such research detracts from the more important activities of building, flying and showing models. Pseudo-scale planes would be judged on creativity, realism, craftsmanship and realistic flight.

Considering how many full-size planes have been built and flown in the past 100 years, a comparatively small number have been chosen as subjects to model. Some have always been popular not only with the competition scale modeler, but also with the



Another of Jim's original designs—a two-place homebuilt aircraft. It's a V-tail pusher design using non-molded composite construction, retractable landing gear (mono main gear with nose gear and outrigger gear), full-span flaps with spoileron roll controls (mini ailerons for control feel), manual folding wings and a nose baggage compartment that has an integral landing light. The nose compartment swings aside to reduce the fuselage's length for smaller hangars.

A fine example of a model that looks real but isn't a scale model of a full size aircraft is the BVM* Maverick. It has all the appeal of a scale jet fighter but let's the modeler express his originality in the way the kit is detailed and painted.

modeler who just likes to have a more or less scale-looking plane. Cubs are always popular, and currently, AT-6 Texans and Sukhois are in vogue. The choices appear limited, but maybe the limited diversity of kits is to blame.

But with pseudo scale, every plane would be an original, and that would be much more exciting for builders and spectators. Even if the manufacturers were to produce pseudo-scale kits, the builder could still win against an identical kit, because craftsmanship *and* originality would be scored. There would be much more to appreciate than just different paint jobs and finishes. The greater the discussion about whether an airplane looks more like a Super Snort Skyblaster than a Dingle Dell Air Carriage, the better. It could get to a point where documentation would be needed to prove what the plane is *not*!

CONSIDER THE POSSIBILITIES

If this idea were to catch on, different classes of pseudo-scale would be developed. These could take into account:

- Number of passengers. This would indicate scale size and enhance realism.
- Purpose. What would the plane have been used for if it had really existed?—pleasure, military, for carrying people, for carrying cargo, or as a utility craft such as fire-fighting or rescue?
- Whimsy. Something that would never exist in the real world, but looks as if it could.

The possibilities are limited only by your imagination! You could address concerns about aerodynamics; and you could implement improved flying characteristics, instead of being stuck with somebody else's ideas, which don't translate well to, say, ¼ scale.

Maybe pseudo scale will never fly with "scalers," but like inventors, pseudo scalers are unlikely to be conformists. Maybe this idea will never fly, because it sounds too difficult or too different. But maybe this is just what certain modelers are looking for. What do you think?

About the author

Rupert Kosmala's obsession with planes began in London where he first watched full-size warbirds fly. When he was a teenager, he built free-flight and C/L models, and in 1979, he returned to the hobby. Currently, he rises to the challenge of creating and flying original R/C designs.

R/C Homebuilt Scale

Well-known scale modeler and R/C personality Jerry Nelson of Hillsboro, OR, once proposed (and still actively promotes) a scale event called "R/C homebuilt scale" that would include many aspects of pseudo scale. Jerry wanted to see an event in which ¼- and ⅓-scale homebuilt models could compete as planes do in the Experimental Aircraft Association (EAA) fly-in held annually in Oshkosh, WI.

In his proposal, Jerry outlined a class called "prototype scale," in which modelers would build ⅓- and ¼-scale models of homebuilt aircraft that haven't been built yet!—off the wall, yes; but a very simple concept.

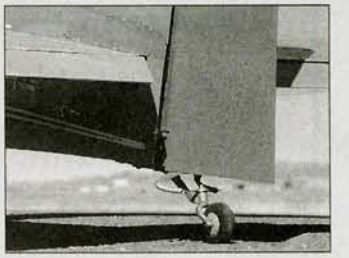
Jerry Nelson of Nelson Aircraft promotes original-design models that look scale but aren't. Shown here is his all-aluminum AL-1 model—a good example of pseudo-scale thinking.

If you were to build a full-size experimental homebuilt aircraft, you'd have to consider several design parameters, including provisions for pilots, engines, control-system installation, landing-gear installation, seats, lights, an instrument panel, etc. If all these factors and considerations have been established and the general design has been put down on paper, then obviously, an airplane has been designed. The prototype-scale event would take this concept one step further and would require that a ⅓- or ¼-scale model be built following these full-size-design considerations.

Yes, you'll need a pilot, too! The idea is to make the model look as if it could be an actual full-size craft.

Following IMAA guidelines, prototype scale models of monoplanes would require a wingspan of at least 80 inches, and bipes would have to have a span of at least 60 inches. A scale pilot would be carried, and the engine cowl would have to be large enough to house a ⅓- or ¼-scale engine such as a Lycoming, Continental, Rotax, etc. Then you'd simply fill in the lines, and build your prototype model. Sounds like fun!

Pseudo-scale and prototype-scale planes must house an instrument panel. Here's the one in Jerry's AL-1.



Details, details! The great thing about pseudo scale and prototype scale is that you're free to include all the details associated with scale models, such as tail wheels, rivets and screws panels.

A Legendary Breed

Pitts

WHAT MAKES a Pitts Special so special? Picture this: you're sitting in a shoulder-width womb spun of steel tube and fabric. You lean back, ignoring the maze of straps that hold you in and the parachute that snuggles up to your backside. Your legs are spread wide and disappear under the panel to rudder pedals you can't see. The engine, perched just a few inches from the soles of your sneakers, snarls up between your feet, its exhaust barking so sharp and nasty as to make your eardrums ache if you're foolish enough to have saddled up without a headset. Clear Plexiglas wraps over your head, and the fuselage sides flow up around your chin to define the limits of the thunder-filled cavern you call the cockpit.

The S-2B with its 260hp engine and three-blade composite prop is still available and is guaranteed to blow minds.

The so-called "roundwing" S-1 S Pitts is the reason we were able to beat the Soviet Bloc countries and win all the team and individual gold medals in the 1971 World Aerobatic Contest.

by BUDD DAVISSON

Your right hand gently wraps around the control stick, which feels alive to your touch. Although the cockpit is absolutely filled with movement and noise, none of it is felt in the stick. The stick is quiet. And smooth. And waits only for your touch to connect you to the airplane's nervous system.

There is a certain amount of confusion as your fingers wrap around the stick. You can't tell for sure whether the control stick is there or not because, the second you ask the airplane to do something, the stick ceases to exist. Your perception is that you control the picture over the nose with your mind. Not your hand. As you think a change in what you see over the nose, the airplane instantly executes that change. And therein lies the seed for possible confusion. The link of mind to hand, hand to stick, stick to airplane, airplane to sight picture doesn't exist. The control progression goes directly from mind to sight picture, with nothing in between.

If you can think it, the airplane can, and will, do it.

What makes a Pitts Special so special? We just told you!

From that moment in 1945 when the first Pitts Special climbed into the air with its little 55hp Lycoming and wheezed its way upward, the world has been in love with the tiny biplane. In the very beginning, it was hard not to love a beautifully proportioned biplane that was so...well...so beautifully proportioned. Later, as pilots began

In 1990, the Friends of Curtis Pitts built a flying replica of the first Pitts Special, including the 55hp Lycoming engine.

The "Big Stinker"—prototype S-2 Pitts—was designed to be a trainer that can give unlimited aerobatic performance.

The S-2A—the first certified Pitts Special—used a 200hp Lycoming with a constant-speed prop.

The single-place S-1 T has the same 200hp engine and prop as th S-2A, but only about two-thirds the weight, so it can really boogie!

PHOTOS BY BUDD DAVISSON

He came up with a unique combination of symmetrical airfoils that used a thicker section on the bottom wing than on the top one. This ensured that, regardless of whether the airplane was right-side-up or upside-down, the forward wing always stalled first and pitched the nose down. The concept was so unique that Pitts was able to patent it.

Curtis Pitts and his original Pitts Special in 1945. This plane had a 55hp engine, rigid landing gear and balloon tires.

to put larger engines in it, we loved it because its slightly pugnacious appearance became a kick-butt reality.

IN THE BEGINNING

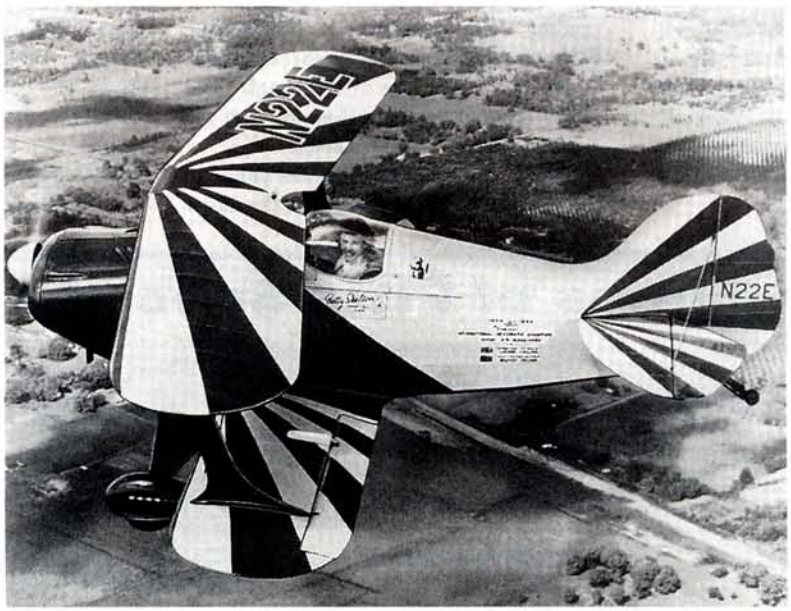
In several areas, the original airplane was different from what we think of as a Pitts Special, its little 55hp 0-145 Lycoming being the major difference. But the original airplane weighed just a little under 500 pounds, so even with its little engine, it was still a bundle of grins. With a wingspan of 16 feet, it was tiny, and its gear was rigid, so the Pitts depended on the doughnut-shaped 7:00 x 4 tires for shock absorption.

A duster pilot talked Curtis out of the first airplane shortly after he had finished it, but he had already started on another one with a bigger engine—an 85hp, fuel-injected Continental. It was this airplane that eventually had as much an effect on pilots and modelers as any before or since.

Pitts had taken the airplane to many air shows, and at one of them, a petite brunette walked up and asked if she could sit in it. In those days, "women's lib" hadn't been invented, and Curtis still talks about that day when his friends chased Betty Skelton—a "mere female"—away from his airplane. Later, she bought the airplane, renamed it Lil' Stinker, and during the 1940s and '50s, went on to become the most famous aerobatic pilot in the world.

Lil' Stinker did more than infect pilots with the desire for a nimble little aerobatic airplane. When it was first kitted as a U-control model, it became one of the most popular models of the decade, and it infected an entire generation of young modelers with the same desire. A huge number of later sport pilots, including me, can trace their beginnings as serious aviators back to that U-control model.

Eventually, as the breed evolved, the standard engine became the 180hp Lycoming swinging a fixed-pitch prop that made the little bipe into an absolute thunder monster. It could out-climb, out-roll and out-everything any airplane in the world. With one exception: with its flat-bottom, M-6 airfoil, the S-1C Pitts couldn't do outside maneuvers as well as some of the European specials on the '60's competition scene.



Betty Skelton in the her "Little Stinker" Pitts Special somewhere over Tampa, FL, in 1950.

A NEED FOR A CHANGE

A self-taught engineer and duster pilot/operator, Pitts wasn't about to let any of those tweed-suited, nose-in-the-air Europeans beat him at his own game. So he came up with a unique combination of symmetrical airfoils that used a thicker section on the bottom wing than on the top one. This ensured that, regardless of whether the airplane was right-side-up or upside-down, the forward wing always stalled first and pitched the nose down. The concept was so unique that Pitts was able to patent it.

This new model, which had four ailerons instead of two, was designated S-1S (for symmetrical) and, were it not for that airplane, the U.S. may never have won a world aerobatic championship. In 1972, the U.S. team and its S-1Ss took both the men's and women's divisions as well as the team trophies—the only time that has happened, before or since.

As the single-seat S-1S was kicking aerobatic keesters all around the world, it became obvious to Curtis Pitts that an airplane that would allow instructors to teach the new, high-stress maneuvers that were becoming part of aerobatic competition was needed. The world needed a two-place trainer capable of flying unlimited category aerobatics. And the Pitts S-2 series was born.

To certify an airplane to FAA standards is a terrifying concept, horrifically expensive and a project not taken lightly by the largest of aviation concerns, much less by an individual with nothing more than a grass strip and a tin hangar next to an orange grove. However, working with several mechanics and an engineering consultant, Gene Deering, Curtis actually got the airplane certified and then formed a company in Afton, WY, to build the airplane. From

that day forward, Afton has been home to the certified Pitts Specials. The company has passed through several owners, including Christen Industries, and it's now known as Aviat Aircraft. But the biplanes are still Pitts Specials.

VARIATIONS ON A THEME

Along the way, a wide variety of Pitts were developed and built. The S-2 was produced as the S-2A with a 200hp Lycoming and a constant-speed prop. Then the airframe was fitted with a 260hp Lycoming, the front seat was eliminated, and the S-2S was born. Many consider this to be the "best handling" of the bigger Pitts.

During the early 1980s, the front seat was put back in, and the S-2B was introduced (still in production today). For a measly $130,000 you can have one of your very own.

Eventually, the S-1S was also certified and then fitted with a 200hp Lycoming and a constant-speed prop and named the S-1T. It, too, is still in production. How much? Don't ask!

So, where is Curtis Pitts these days? In answer to that question, my phone rang not long ago and a familiar, slow, deep voice drawled, "Budd, we've got this new airplane finished," I held my breath, waiting for the next words. "If you want, you can come down and fly it."

CHANCE OF A LIFETIME

I don't remember packing, but when I arrived at Curtis's place, my clothes bag looked as if I had lobbed my clothes into it from across the room. Did I want to fly it?! Silly question!

As I walked toward the new Pitts, I couldn't help but be excited; a 260hp in such a tiny package! Yee-hah! This looked like fun!

This is the sixth S-2A off of the assembly line. Author Budd Davisson owned this aircraft for 23 years.

Inspecting the airplane—officially known in Pittsdom as the Model 11—I couldn't help but notice its differences from and similarities to the other airplanes. I also got a kick out of the tough little skunk painted on the tail along with the airplane's name, "Super Stinker."

In size, the new airplane was closer to the single-place airplane than to the larger ones, since the wings were only a foot longer. The single-piece top wing was swept back like those on all Pitts, but the wingtips were slightly squared off so that the ailerons could go out as far as possible for maximum effectiveness. Curtis had designed the airplane to go nose-to-nose with the new breed of hot-dog monoplanes, and that meant having an eye-blurring roll rate, so the ailerons really had to do their thing.

As I slid down inside the airplane, I was struck by the differences in the way its cockpit fit. Rather than disappearing from sight to peek out of the deep cockpit like a prairie dog, I found a shallow cockpit that afforded great visibility—relatively speaking, that is. With its nose stretching out in the distance and the seat leaning back, it felt more like some of the monoplanes. "Yessir," I said to myself. This was definitely going to be fun!

As the 260 Lycoming barked into life, I started to taxi out and then came to a jerky halt and motioned one of the guys over. He looked surprised when I opened the canopy and handed him my cowboy boots—the only type of footwear I own. The pedals were adjusted so far forward that the boots just slid up the brakes, and I didn't want to take a chance with them, so I flew barefoot!

Lined up on the runway, I took a deep

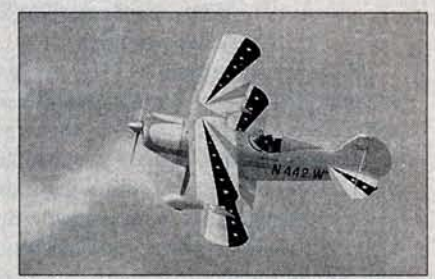
Useful sources of Pitts Special kits

Ace R/C

■ **Weeks Special,** 1/3 scale
Span 72 in.; length: 64 in. w/4-inch spinner; ST 3000, Q-35 to 40, G-38 etc.; rolled plans; built-up wood; aluminum landing gear; formed canopy; epoxy/glass cowl and wheel pants. $314.95

Aero Dynamics

■ **S2A,** 40 percent scale
Span: 96 in.; length: 90 in; 7ci., two-cylinder engine or equivalent; built-up ribs and tube/truss fuselage construction (similar to full-scale); landing gear; engine mount and cabane struts are welded steel and wing LE and TE and aileron LE sheeting are aluminum sheeted. $2,500



This flight shot of Ted White's S-2A shows just how great Pitts Specials look when airborne.

Bob Dively Models

■ **S-2,** 1/3 scale
Span: 80 in.; length: 69 in.; 2.4 to 4.6ci; built-up wood, carbon-fiber one-piece cabanes and aileron horns; fiberglass cowl and wheel pants, windshield and canopy; aluminum fuselage sheeting. $429

Byron Originals

■ **S-1,** 1/3 scale
Span: 68 in.; length: 62 in.; ST 2500-3000, Moki 1.80 or equivalent; injected foam wings and fuselage construction. $419.95
Extra engine mount: $50.60

The Aero Dynamics 40-percent S-2A is impressive on the ground and on the wing.

ISC International

■ **S-2,** 28-percent-scale modified Sean Tucker 1-800 Collect Challenger
Span: 64 in.; G-62 or equivalent; built-up balsa and plywood; fiberglass wheel pants and cowl. $695

Midwest Products

■ **Super Stinker 11-260,** 27-percent scale
Span: 60 in.; 1.08 to 1.8 2 stroke to 1.5 to 3.0

breath and started the throttle forward. As those six cylinders converted fuel to adrenaline, the airplane became a missile with a man in it—a man wearing a very wide grin! I had barely raised the tail when the airplane blasted into the air like a 30-06 round, and I knew I was in serious trouble! I was already so in love with this airplane that I could feel this sucking sensation in the vicinity of my wallet, and I wasn't even at the end of the runway yet. I had to have one of these things!

I hauled the nose up until I was lying on my back at a ridiculous angle, watching the altimeter wind up. And up. And up!

Curtis had told me I wouldn't like the ailerons because they were so light. Yes, they were, but they were vintage Curtis Pitts as well. The feeling of being connected directly to the slipstream was definitely there, along with a roll rate as fast as I've ever seen. At full deflection, the horizon actually does blur the first few times you roll it.

Pulling vertical, I slammed the aileron in and promptly lost track of where I had started. That first time, I don't have any idea how many times I went around. But the instant I centered the ailerons, my head hit the canopy side because the plane stopped rolling so quickly.

I hammerheaded out, pulled level and banged around in four- and eight-point rolls. Yep! I was seriously in love. It started and stopped like a finely tuned machine. It could have been a pattern ship the way it handled.

When I came in to land, it fell out of the air even faster than most Pitts because of that big prop flattening out, but what a blast it was! I'd touch down, nail the power and instantly pull up into a max performance...climbing turn back onto downwind...kill the power...and fall out of the sky again. I must have done this a dozen times; I was having so much fun, I couldn't stand it! As I begrudgingly gave Curtis back his airplane, I looked back at it with lust in my heart. And nothing in my wallet. Fortunately!

Maybe I can't own the real thing (I already have an S-2A, remember?) but the Super Stinker is made to be modeled. With its longer fuselage and wide, aluminum gear, it will make a far more stable model and a better performer than the earlier, single-place Pitts. Besides that, with the blazing performance of the real airplane, the modeler doesn't have to worry about having far more than scale performance. In fact, he may have to work to match the real airplane's rambunctious behavior. The Aviat-modified version being flown in the '96 World Aerobatic Championship by Robert Armstrong has 300+hp and even more performance.

Just remember: anything with "Stinker" in its name is a real performer, and this one's first name is "Super." Nuff said?

4-stroke; built-up kit featuring micro-cut ply and balsa; complete hardware package; ABS cowl; wheel pants and clear canopy; part no. 182. $374.95
Separate scale instrument panel; part no. 1094. $24.95

Paul's Flying Stuff

■ **S2A**
Span: 41 in.; length: 34 in.; .29 to .40; all-wood construction; epoxy/glass cowl and wheels pants; molded cabane struts; canopy; full-size plans; instruction manual. $99.95

Pica/Robbe Inc.

■ **S-1S Electric**
Span: 39⅜ in.; length: 35 in.; 600-size or larger motor ; 7- to 10-cell battery pack; all-wood kit; vacuum-formed cowl and canopy; formed landing gear; hardware package, etc. $215.80

Royal

■ **S-2,** 2.6 in./1 ft. scale
Span: 52 in.; length: 42⅝ in.; .60 to .80 2-stroke; all balsa and plywood kit; aluminum dural landing gear. $214.95

A Byron Originals S-1 in its traditional, red, Pitts paint job comes in for a successful landing.

■ **S-2A, semi-scale**
Span: 31½ in.; length: 30½ in.; .09 to .21 2-stroke; all balsa and plywood kit; aluminum dural landing gear; fiberglass cowl and molded wheel pants. $109.95

■ Lil' Stinker, 2⅞ in./1 ft. scale
Span: 51⅜16 in.; length: 44¼ in.; .49 to .60 2-stroke; all balsa and plywood kit; aluminum dural landing gear. $209.95

For the addresses of the companies listed here, turn to our Index of Manufacturers.

About the author

Budd Davisson bought his first Pitts—the sixth S-2A off the production line—in 1971. According to him, "The Pitts Special demands that its pilot be a pilot. It reflects exactly what the pilot does and what the pilot is thinking. If he recognizes he has a really fine, sharp tool in his hands and he grows to meet the qualities of the machine, he'll find it to be just an absolute extension of his soul."

Budd was bitten by the aviation bug when he started building model control-line airplanes at age 10 or 11, and he was heavily influenced by the Berkeley Lil' Stinker kit of the Pitts Special. Although the nearest airport was 25 miles away, he started flying full-size airplanes at 15, soloed at 16 and got his license when he was 17. Since then, he has logged nearly 5,000 flight hours in about 210 types of aircraft. Budd almost never flies other people's aircraft just for the sheer fun of it because, as he comments, "I'm on the back side of the statistical curve; the likelihood of something happening is getting higher and higher, so I make it a point not to fly other folk's unusual airplanes unless there's a reason to." A degree in Aeronautical Engineering has also allowed him to work on numerous aviation design projects, including replicas of the no. 1 1945 Pitts Special and Wedell-Williams racer.

As a freelance photojournalist, Budd has more than 250 covers to his credit and says, "After you've shot thousands and thousands of rolls of film, if you don't know what you're doing, you'd better hang it up.... It has nothing to do with talent; it has to do with perseverance."

To R/C'ers who dream of flying a full-size airplane, Budd has this advice: "There's a tendency for people to think that flying an airplane is an unobtainable skill when it's absolutely not. If full-scale airplanes were as hard to fly as R/C airplanes, aviation would have died in 1904. I can generally take an R/C pilot and teach him aerobatics in nothing flat. They do extraordinarily well."

—Debra Sharp

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

Updating a classic sport plane

The Hobby Lobby .60-size skis work well with the Thunder Tiger Stick. Taxiing on snow presents some interesting problems, especially in wind. When taxiing a tail-dragger in a crosswind, hold the tail down with up-elevator, steer with the rudder, use the throttle for forward motion, and keep the ailerons "into the wind."*

Thunder Tiger

Tiger Stick 40

by JACK HAYEK

I CONSIDER MYSELF a builder of modest skill and equally modest flying ability, so I probably represent a significant number of the enthusiasts who taxi their models out and breathe again only when the first flight has been successfully completed. When I was asked to review the Thunder Tiger* Tiger Stick .40, I agreed, because I know what a great performer Das Ugly Stik (ancestor of the Tiger Stick) was. In very little building time, this plane is ready to fly, so let's get to work.

THE KIT

The packing arrangement of the kit's components is well-thought-out, and the wing halves, fuselage and tail feathers are ready to go. The complete package of hardware includes a fuel tank, an engine mount, landing gear, a spinner, pushrods and wheels.

Before you get started, read the exceptionally well-written and well-illustrated instruction manual thoroughly. This has to be one of the very best instruction manuals that I have seen.

My box's contents matched the illustrated parts list, and the few additional items that I needed were readily available at my workbench. Because Thunder Tiger recommends the Tiger Stick as a second sport model, not a trainer, most of the items needed to complete it will be available to the typical builder.

• **Wing.** This assembly is first on the agenda. The instructions are clear, but the wing joiner is a nearly perfect 90-degree rectangle, and that means an almost complete lack of dihedral. The illustration shows a more pronounced dihedral, so ignore the angle in the illustration, and place the slightly concave surface toward the wing's upper surface. If you have a problem distinguishing which side is up, trace the joiner onto a piece of white paper. When you look at the drawing, you'll be able to distinguish the top side of the joiner.

Trial-fit the aileron servo before you permanently join the wing halves; this will save you anguish later on. When I installed the wing servo tray, to provide an exit for the servo lead, I cut a small

FLIGHT PERFORMANCE

by ROGER POST JR.

Because I have flown Das Ugly Stik, I knew this would be a pleasant experience. What I didn't count on was the frigid weather. However, when you're on a mission to meet a deadline and you just generally love to fly, not even a 9-degree (wind chill factored in) temperature and 2 feet of snow will stop you. After I had done a thorough preflight at home, I called our staff photographer, Walter, and we headed to the field.

• Takeoff and landing

Once the Thunder Tiger Pro .46 had been "tuned" (richened high and low ends) for the weather conditions, I checked the radio range and the movement of the surfaces and prepared for takeoff. The Tiger Stick used about 40 feet of runway to become airborne. It needed some right rudder during the takeoff (so make sure your rudder thumb is ready). During the procedure turn, I noticed some adverse yaw, so coordinate your rudder and ailerons for turns. The Stick used about ⅔ throttle on the initial takeoff run, but when it was airborne and at a safe altitude, I pulled back the throttle and flew it at a comfortable pace. Your takeoff condition will probably vary considerably from mine, so the runway length and throttle setting will be different.

Because of its thick, symmetrical airfoil, the Tiger Stick was easy to land. I lined it up with the runway, chopped the throttle and gradually pulled back on the stick. The plane slowed down to trainer landing speed, but it still had enough momentum to carry it to the landing strip. I had a dead-stick landing (I ran out of fuel!) on the first flight, and I thought that the plane wouldn't make it back because of the headwind. Wrong! The Stick kept penetrating the wind and, as it neared the runway, I kept pulling back gently on the elevator stick; it gradually gained a little altitude and glided right in for a perfect landing. With the engine running at idle, the prop acted as an air brake; this also helped to slow the model down on the approach. The recommended control throws provided more than enough surface deflection to handle crosswinds on takeoffs and landings.

• Low-speed performance

The Tiger Stick performed well at slow air speeds. It can fly at slow airspeeds for as long as the fuel lasts. The power-off stall was straight ahead, and to recover, I just added power, kept the wings level with the rudder (most effective wing leveler at slow air speeds) and flew out of the stall.

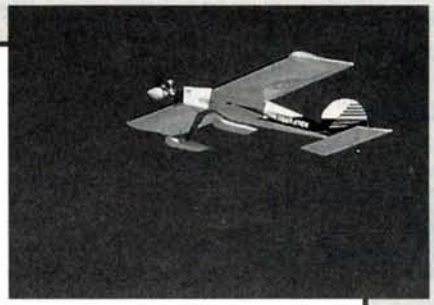
• High-speed performance

At full throttle, the Thunder Tiger Pro .46 is a powerful engine. It pulled the 5.1-pound Stick around the sky with no problem. The top speed was estimated to be around 50mph plus, and the plane handled this speed well. The power-on stall (full throttle, high angle of attack) was basically a climb until the plane lost its forward speed. Once the climb had stopped, the Stick gently fell forward and started to fly again—an easy recovery.

• Aerobatics

The Thunder Tiger Stick is a fully aerobatic aircraft that's capable of pattern work and hot-dogging maneuvers. This model was set up according to the instructions, and there was plenty of control throw to do all the stunts. Loops were easy; just be sure to let off some of the stick pressure at the top of the loop so that it comes out round. Wingovers, stall-turns and hammerheads were easily accomplished with a powerful vertical maneuver followed by a kick of the rudder and a drop in the power. Inverted flight used only a little forward stick, and rolls were moderately fast and axial. Knife-edge used about ½ of the rudder deflection, and I had to hold some down-elevator to keep it tracking straight. I initiated a spin with full left rudder, aileron and up-elevator, and the Stick spun like a top; recovery was quick with everything released to neutral and some opposite rudder to the rotation added in. Snap rolls were more like barrel rolls; I suggest you increase the throws for a tighter snap.

If you're past the trainer and semisymmetrical stage of flying, check out the Tiger Stick .40. It lands like a slower trainer, but it can really perform when you pull out all the stops. I would have flown it all day, but my fingers and toes started to complain about the cold. Happy landings.



Takeoff and climb-out are effortless. Just add some right rudder to keep the Tiger Stick tracking straight.

SPECIFICATIONS

Manufacturer: Thunder Tiger Model Co.

Model name: Tiger Stick .40

Type: sport/aerobatic

Wingspan: 58.5 in.

Wing area: 714 sq. in.

Wing loading: 16.5 oz./sq. ft.

Weight: 5.1 lb.

Length: 50.1 in.

Engine req'd: .36 to .46 2-stroke

Engine used: Thunder Tiger Pro .46 ABC R/C

Prop used: 11x6 Master Airscrew*

No. of channels req'd: 4 (throttle, rudder, elevator, aileron)

Airfoil: symmetrical

Construction: balsa/ply, factory-covered ARF

List price: $169.99

Features: 90-percent-complete kit with a colorful design scheme; fully symmetrical airfoil with advanced aerodynamic design; adjustable engine mount; aluminum dural landing gear; bolt-on wings; can be set up with trike gear or as a tail-dragger; complete hardware package included; photo-illustrated instruction manual.

Comments: the Tiger Stick .40 is a pleasure to build. The major components are well-built and warp-free. Everything goes together with minimal trial-fitting and sanding, and the completed plane looks appealing. The adjustable engine mount and the pre-drilled firewall are real pluses, as are the pre-drilled and mounted wing hold-down blocks. I'd like to see a stronger method of attaching the dural landing gear and additional wood to which the horizontal stab can be glued. Overall, it's a great kit, and I'm sure you'll enjoy building and flying it.

Hits

- Excellent instruction manual.
- Great aerobatic capabilities, yet lands as slowly as a trainer.
- Easy to build.

Misses

- Landing-gear attachment could use strengthening.
- Needs a little more surface on which to glue the horizontal stab (see text).

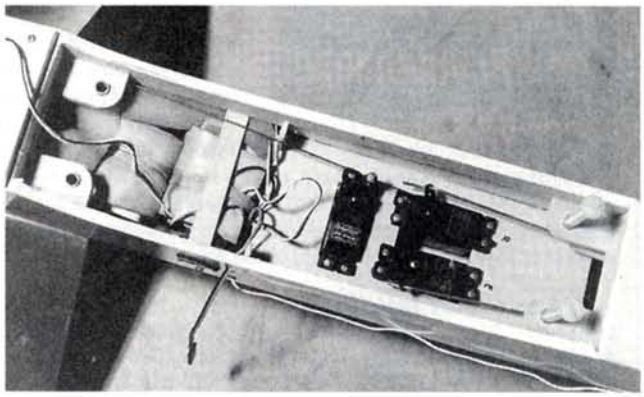
notch in the tray and the wing cutout. After this, I installed the aileron servo.

I epoxied the ailerons into place and jiggled them from time to time to make certain that the hinges were free. (Nothing is more frustrating than having to loosen up those ailerons later on.) When the epoxy had cured, I gave each aileron a good yank to be certain it was there to stay.

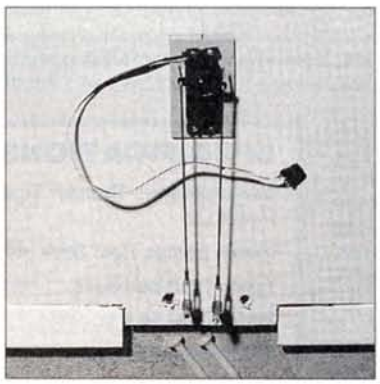
• **Fuselage.** The fuselage comes just about ready to roll; it even includes installed and completed wing hold-

down blocks. I recommend that you fuel-proof the engine bulkhead and fuel-tank compartment.

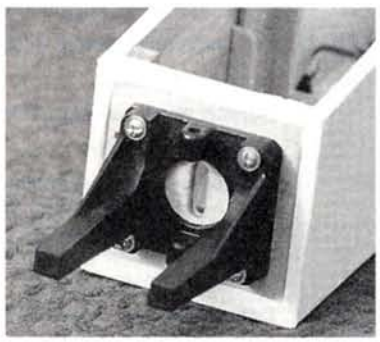
When I installed the landing gear, I epoxied an extra layer of plywood to the underside of the fuselage where the landing gear is attached. The extra strength there is well worth the additional ounce or so. Tricycle gear is an option, but I went with the tail-dragger version because my club's flying field is a short, grass strip. The tail-dragger is more forgiving of my occasional less-than-perfect landings. I recommend that you attach this extra piece of plywood with screws that are held in with blind nuts; this added attachment strength will help the plane to survive rough landings.



Here's the suggested radio setup. To balance the Stick, I had to move the battery to the back of the compartment and halfway into the covered aft section.



The installed aileron servo with the fuel-line "keepers" holding the ends of the clevis together. Before you glue your wing halves together, cut out the area for the aileron servo and the servo lead.



The new, adjustable engine mount can be widened to accept larger engines, and it has the nose-gear retention brackets molded into place. The web portion of the extended arm should be on the same side as the engine's cylinder.

• **Assembly.** Installing the tail feathers is simply a matter of following the instructions. Check their alignment from time to time as the epoxy cures. To provide more of a gluing surface when you attach the tail, fit and glue a piece of balsa to the inside of the area where the horizontal tail will be attached. For the tail-wheel installation, you may have to drill the hole in the rudder and prepare the groove for the tail-wheel strut.

• **Engine and radio.** Installing the engine and the radio is by the book and presents no unusual problems. I installed the Thunder Tiger Pro .46 ABC and used the new adjustable engine mount that comes with the kit. I initially placed the battery pack directly behind the fuel tank, but when I tried to balance the plane, it was very nose-heavy. I moved the battery pack to the back of the radio compartment (at this point, it was halfway into the aft section of the fuselage), and the plane balanced perfectly.

A GREAT PRODUCT

As I progressed with the building of the Tiger Stick, my enthusiasm continued to grow. Thunder Tiger has produced a high-quality product that is a pleasure to work with! Because I had to travel out of town, I turned the Tiger Stick over to my flying buddy Roger Post for an initial flight evaluation. I'm sure that you'll find this plane easy to build and fly and that you'll enjoy it as much as I have. Good luck, and have some fun with the Stick.

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

About the author

Before his retirement, Iowa-born Jack Hayek worked for IBM, both here in the USA and overseas. He now lives in Connecticut, where he's an active member of the FLYRC club. He has been flying for three years and has a dozen or so models to his building credit.

by MIKE McCONVILLE

MODEL AIRPLANE NEWS HOW TO

Control Linkage for Giant-Scale Models

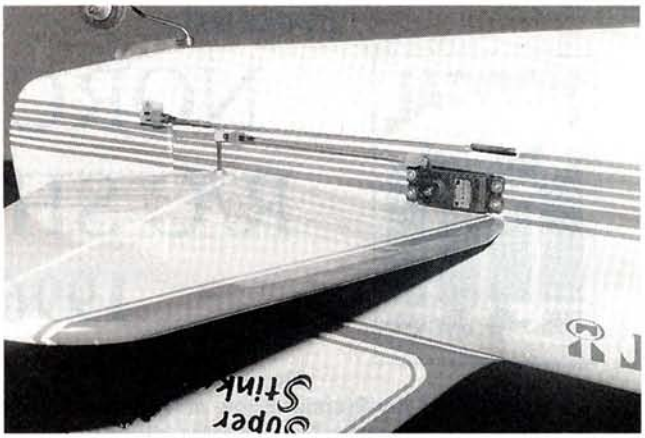
Setups for safe and reliable performance

BIGGER IS BETTER. When it comes to today's model airplanes, there's certainly a strong argument for this statement. Giant-scale airplanes are becoming increasingly popular, but "the world of the giants" presents many factors for consideration. Control-linkage requirements are becoming ever more critical to safety and good performance.

MEASURING UP TO THE TASK

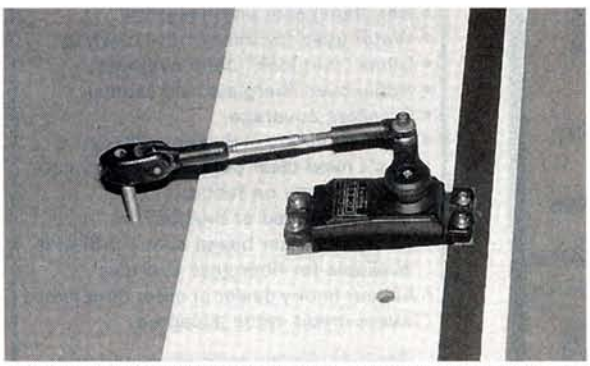
Control systems on typical giant-scale airplanes—1.20 size to 5.8ci and bigger—require more attention than those on smaller models; the bigger the model, the greater the dynamic loads on the airframe and control surfaces. In a smaller model, the integrity of the linkage systems often far exceeds the loads that they see. But on giant-scale models, the linkages are pushed to their limits. There are several areas in control systems that require special attention, and this month, we'll focus on three parts of control linkages that must be correct.

• **Linkage rigidity.** All control linkages must be rigid and free of flexing, or the control surface will not track directly with the servo; at best, the model will feel "squirrely," and at worst, the linkage will fail, and the model will be lost. In most cases, 4-40 hardware is preferable (particularly on bigger gas-burning models) though this depends on the size and type of model. To achieve short, rigid linkages, tail-mounted servos are often used; I used them in the Midwest* Super Stinker.



The tail-mounted elevator servos in my Super Stinker keep linkages short and very rigid. I used Hayes clevises at the horn attachment and soldered clevises at the servo-arm attachment.

For some models, tail-mounted servos do not work because they make the plane tail-heavy or spoil the scale look. In such cases, very stiff pushrods (such as carbon-fiber—available from Aerospace Composites*, or fiberglass—available from Dave Brown Products*) should be used. As shown in the illustration, the pushrod should be supported at the rear to prevent side-to-side movement. Use a short length of brass tube supported by a brace as a bearing for the pushrod to slide through.



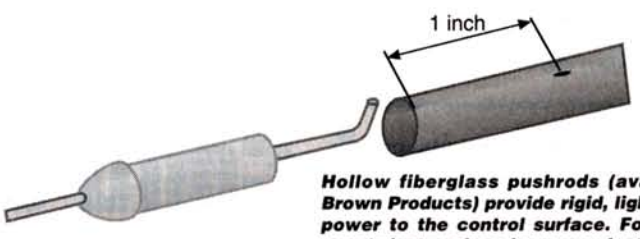
On the stab of my TOC Extra 300S, I used long control horns to maintain mechanical advantage and long, heavy-duty Sonic Tronics servo arms to achieve the necessary control throw; 4-40 hardware is used throughout.

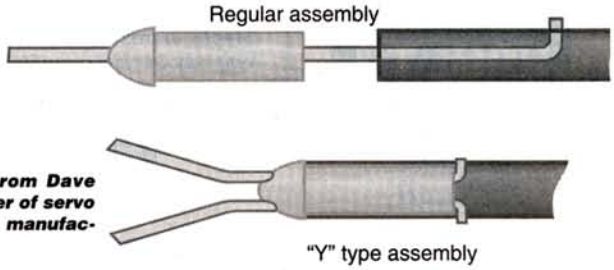
• **Mechanical advantage.** When setting up and adjusting control-surface throws on a small model, we don't usually consider this factor. When we want more throw, we move the linkage attachment point on the control horn closer to the control surface. This shortens the lever arm and decreases the linkage's mechanical advantage, i.e., leverage over the surface. On smaller planes, the forces are usually so small that we will not run into trouble.

On giant-scale models, particularly on high-performance aerobatic types that have large control surfaces, this is an important concern; it isn't safe to move the linkage attachment point closer to the surface to achieve more throw. The loss of mechanical advantage may push the control system past a critical point, and severe flutter may result. Always keep the control horn or lever arm as long as is practical.

If more throw is needed, install a longer arm on the servo, and move the linkage attachment point farther away from the servo-output shaft. Long, glass-filled, nylon, heavy-duty arms available from Du-Bro* and Sonic-Tronics* or aluminum arms available from Hangar Nine* are good choices. The photo shows this principle on the elevator linkages of my 37-percent Extra 300S, which I flew in the 1994 TOC. While practicing for the last TOC, I saw an Extra exactly like mine, using the same elevator servos and powerplant, have elevator flutter in level flight at half throttle; the only difference was its very short elevator horns, which were intended to achieve radical elevator throws.

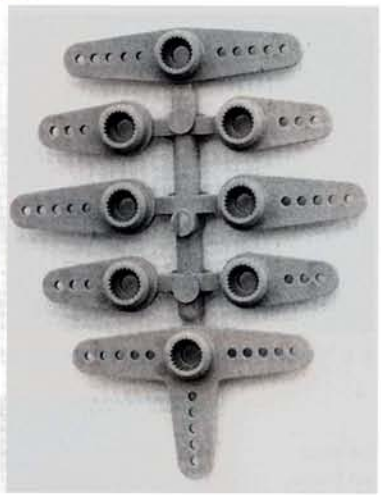
• **Linkage attachments.** These must be secure and free of binding, slop and "twist." Ball-type links are usually preferable because they have no slop, they wear very well and are very secure. The control horn must be rigid and must not flex. The photo of my TOC Extra stab shows Rocket City* giant-scale control horns, which work very well. They consist of an 8-32 bolt (which serves as the control horn) and ball-attachment links. Clevis attachment to the control horn works well, but take care





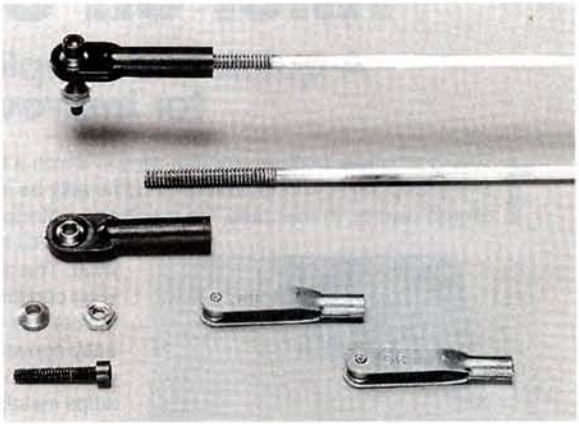
Hollow fiberglass pushrods (available from Dave Brown Products) provide rigid, light transfer of servo power to the control surface. Follow the manufacturer's instructions for proper installation.

Du-Bro's strong, long, fiber-filled heavy-duty servo arms are good for increasing control throws and come with spline patterns for all the major radio brands.



to choose a clevis and horn that don't have slop between the clevis pin and the hole in the horn. The clevis and horn method requires periodic inspection, because the hole in the horn will become worn and the pin's fit will be sloppy. Whenever slop develops, the hardware should be replaced. Avoid metal clevises that are sloppy on the threads of the pushrod; this slop will hurt the model's performance. As you can see in the photo of the Super Stinker tail, Hayes Products* make a high-quality plastic clevis with a metal pin; it can be threaded onto the push-rods tightly, and the metal pin will not become worn. Attachment to the servo is much the same. I prefer Du-Bro swivel links—a ball-type attachment. Z-bends work fine on small sport models, but don't use them on large models. They are usually somewhat sloppy, and they'll wear the hole in the servo arm.

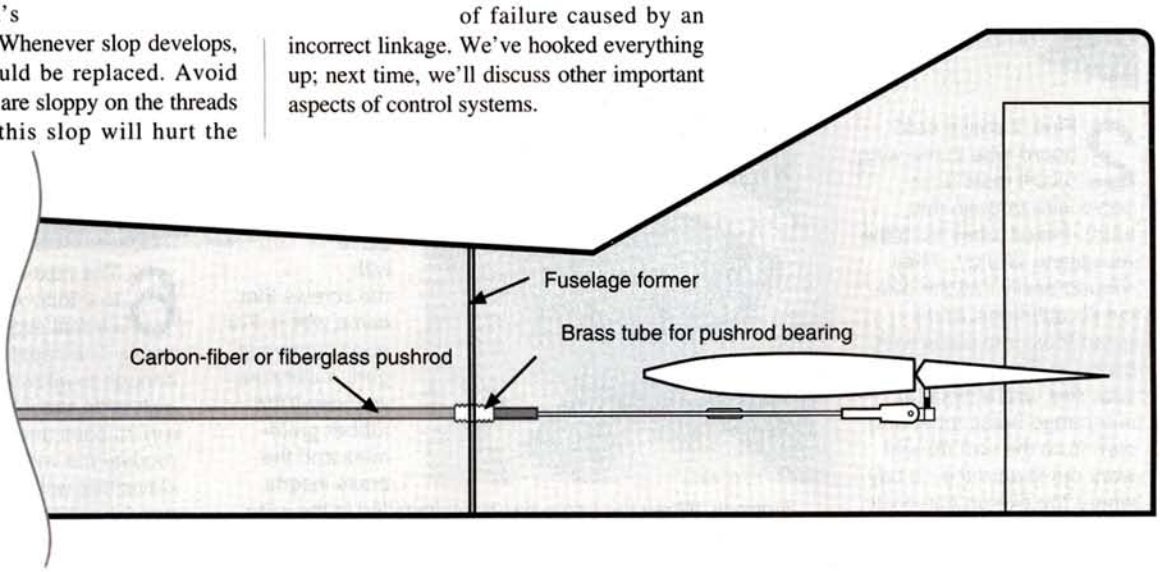
When you think about it, flying an airplane that has sloppy or flexible linkages yields the same effect as flying one that has servos loose in their mounts. With "big birds," there's the added danger of failure caused by an incorrect linkage. We've hooked everything up; next time, we'll discuss other important aspects of control systems.



Du-Bro 4-40 metal clevises and ball swivels should be used on giant-scale models; 4-40 hardware is stronger than 2-56 hardware and better suited to the surface loads that giant-scale models endure.

** Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

Editor's note: in "Control Linkage" in the February 1996 issue, the illustration of a control arm on page 13 was drawn inaccurately. The clevis attachment holes should be aligned with the hinge line of the control surface.



Pushrod installation for a 1.20-size Desire pattern ship. There should be no side play or binding between the pushrod and brass-tube bearing.

MODEL AIRPLANE NEWS

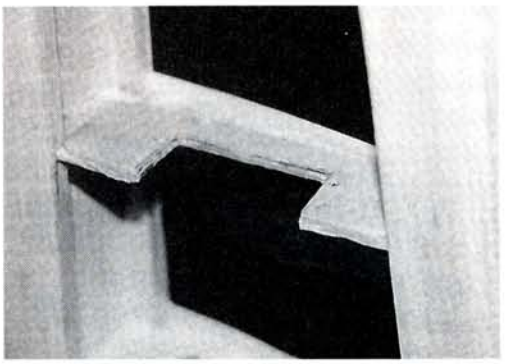
HOW TO

ONE OF THE MOST popular modifications modelers make to their planes is to replace the long wire pushrods and 90-degree bellcranks that handle aileron control with servos mounted directly in front of the control surface. This eliminates many linkage contact points and goes a long way toward reducing control-system slop. Here's one way to do it.

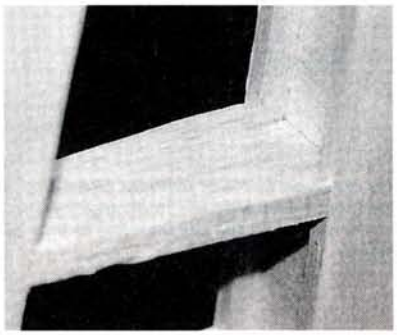
by GERRY YARRISH

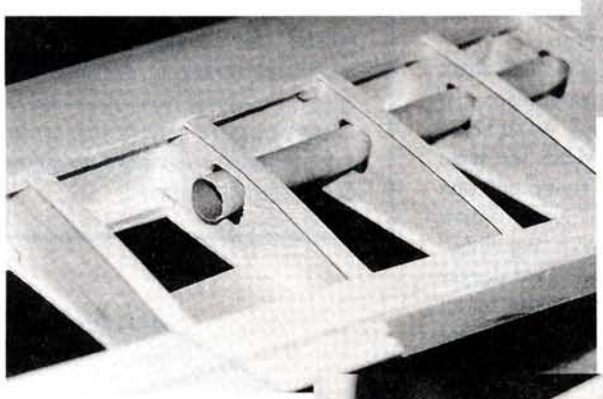
Install Direct-Control Aileron Servos

A quick and simple conversion for improved response

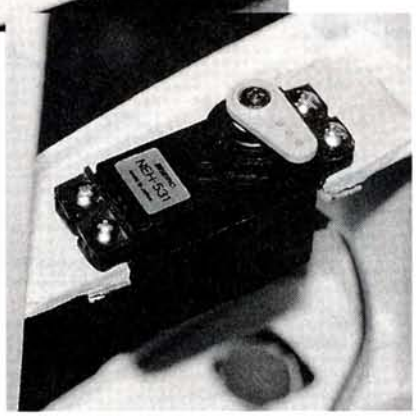


1 This is a typical, built-up wooden wing in which a bellcrank and a long music-wire pushrod would usually be installed for aileron control. In this case, I'm modifying a Model Tech* P-51 ARC Mustang wing. The open-bay wing construction makes this a very easy conversion, but if your wing has capstrips installed on the ribs, you'll need to remove them before you begin. For a fully sheeted wing, first modify the rib, and install the servo before the wing is sheeted. Also, a fully sheeted wing will need a flush-fitting hatch cover for servo access.

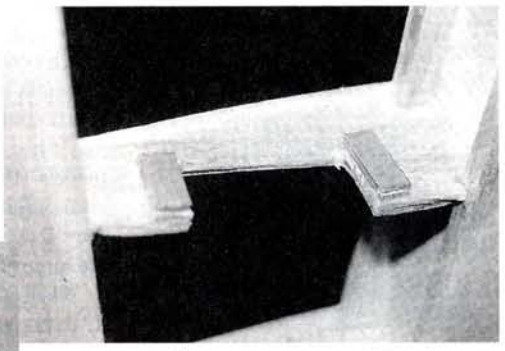




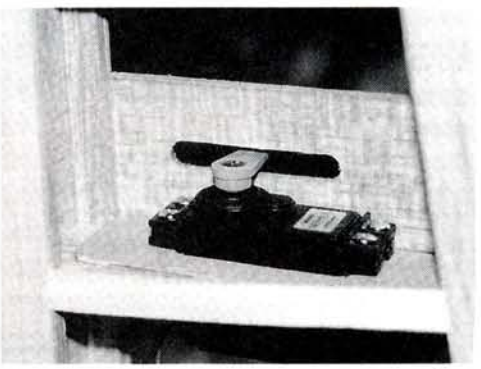
2 First, install a cardboard tube in the wing (you'll route your servo wire through this tube). I used tubes from the Aeroplane Works*. They slipped easily into the precut rib openings, and I glued them into place with thick CA. To cut holes in your ribs, use a piece of sharpened brass tube, and start from the root rib and work out toward the rib bay where the aileron servo will be installed.



3 Next, cut out a piece of 3/32-inch-thick plywood (not lite-ply) to fit your servo and the rib it will be attached to. Before I glued the plywood to the rib, I cut the servo opening in the plywood mount plate and drilled holes for the servo screws. After the ply has been glued into place, cut out the exposed part of the rib where the servo will go.

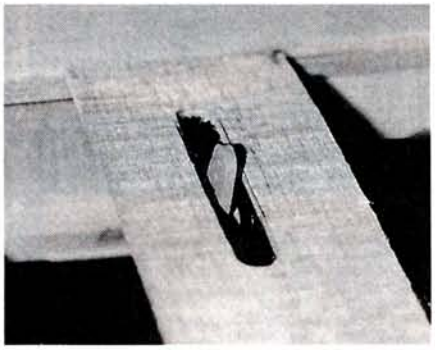


4 To supply more material for the servo screws to "bite" into, add two 3/32-inch-thick strips of plywood to the other side of the rib. After the strips have been glued into place, drill into them through the holes in the mount plate. Use a 1/16-inch-diameter drill bit for standard-size servo screws.

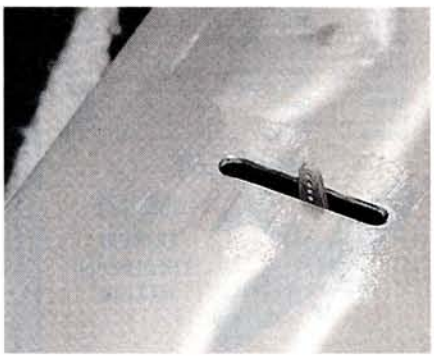


5 Place your servo (here, I'm using a JR* NES-531) in the cut-out area of the mount plate, and screw it into place with the screws that come with it. For good servo support, make sure you install the rubber grommets and the brass inserts properly. When the servo has been installed in the wing, it should be flush with the bottom of the rib.

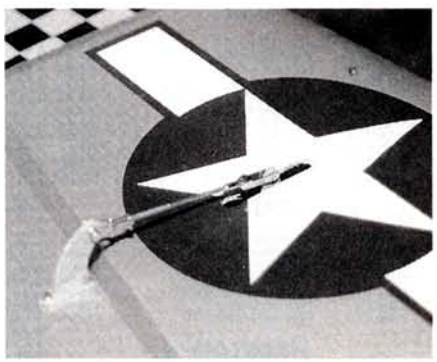
6 The next step is to glue a 1½- to 2-inch-wide capstrip to the rib that supports the aileron servo. The capstrip must be wide enough to allow you to cut a ¼-inch-wide slot into it for the servo arm to pass through and to accommodate the width of the pushrod clevis that will be installed on the arm later. I made my slot 2 inches long.



7 Here's the finished installation. Notice the servo arm protruding through the slot. To sand the capstrip flush with the wing's leading- and trailing-edge sheeting, simply rotate the servo arm until it's beneath the capstrip, and sand it using a sanding block.



8 After the wing has been covered, use an X-Acto knife to cut away the covering over the slot. Then rotate the servo arm until it's in the neutral position, and make up and install your aileron control pushrod.



9 The completed aileron control linkage setup. This conversion is very easy to do and doesn't take much time. If, at a later time, you need to remove the servo or inspect it, simply cut away a portion of the covering between the ribs. A patch of material can then be ironed back into place that will be nearly invisible. Enjoy!

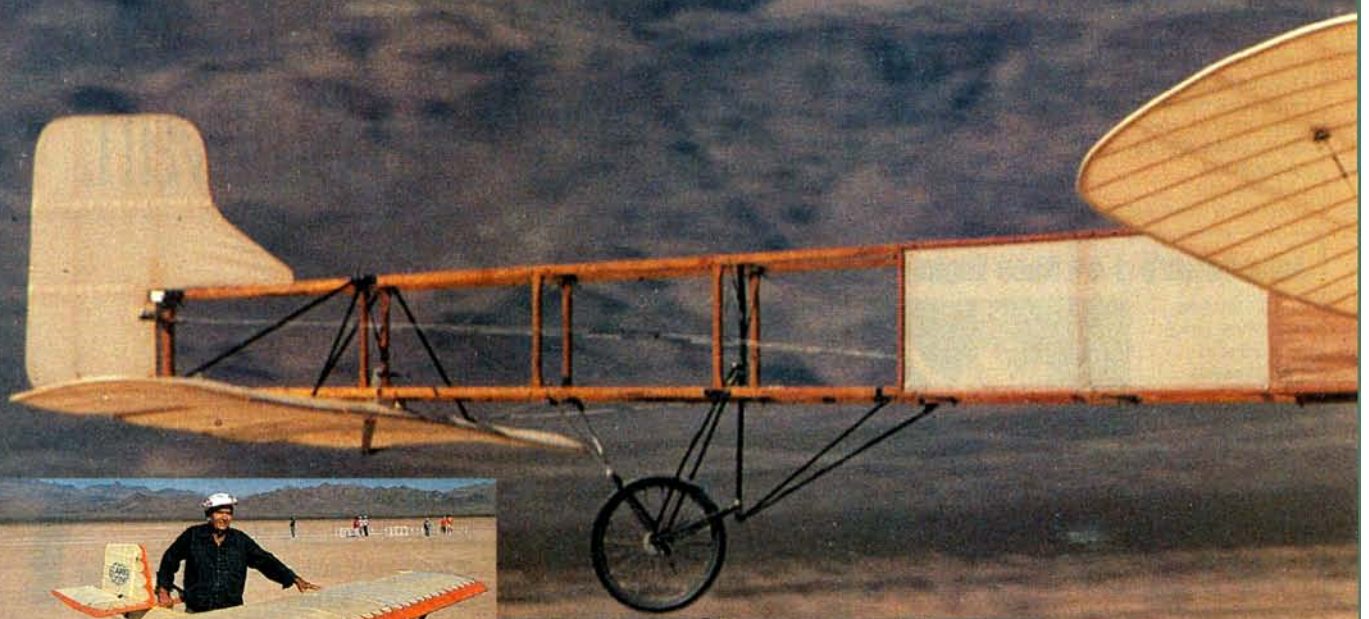
** Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

19TH ANNUAL INTERNAT

Q S A A

by BOB BANKA

Dean Lassek of Littleton, CO, won Best Jet award with his humungous 1/6-scale A-10 Warthog. 120-inch wingspan; Twin O.S.* .91s turning Dynamax* fans; 46 pounds; Futaba* 9ZAP; Robart* retracts; Glennis* wheels; foam and fiberglass construction.



Robin Hambley of Glendale, CA, scratch-built this great-looking 1/2-scale Pietenpol Aircamper. 47 pounds; 14-foot wingspan; Quadra* 80 turning a 24x10 prop; Futaba radio; plywood and balsa construction with Coverite* finish.

Best Multi-Engine winner Nick Rivaldo of Long Beach, CA, shows off his 1/8-scale Ziroli* C-47 that drops paratroopers. 55 pounds; 140-inch wingspan; twin Zenoah G-38s turning 18x8 3-blade props; balsa and plywood construction; Robart retracts.

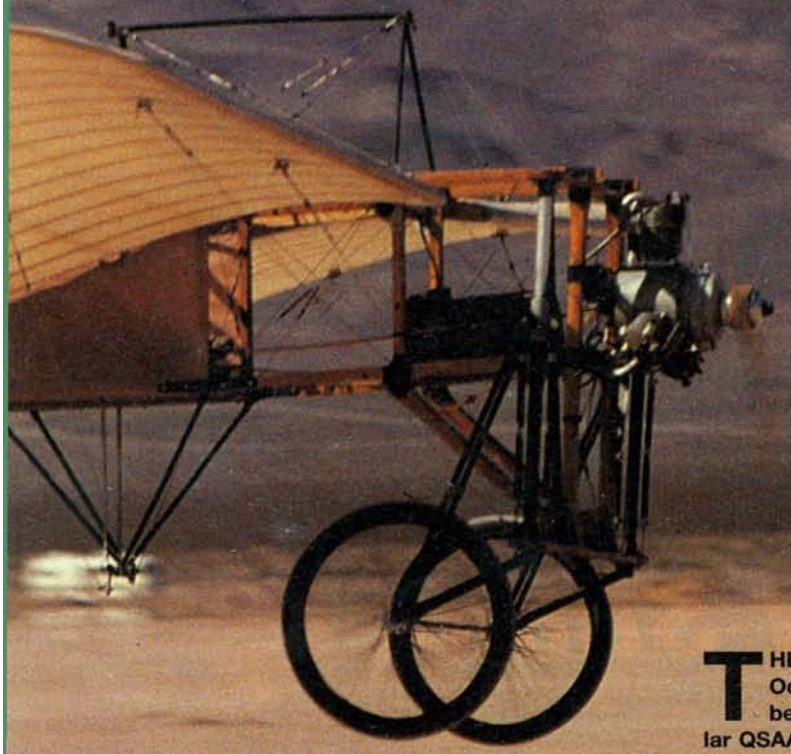
Left: Grant Wilson of Tulsa, OK, poses with his scratch-built B-36 bombers. The bombers are powered by O.S. .32s turning 9x7 pusher props, weigh 26 pounds and have wingspans of 112 inches. Tru-Turn spinners, JR radio.

The Mechanical Achievement award went to Dale Yaney of Hemet, CA, with his striking RB-35 Northrop flying wing. 32 pounds; 145-inch wingspan; four O.S. .32 engines turning 10x7 props; wood and fiberglass construction; homemade retracts; retract doors and spoiler control; JR PCM 10.

L GIANT-SCALE SHOOTOUT

FLY-IN

Winners of the Best Electric award, Tony and Addie Naccarato of Burbank, CA, with their Hill Pterodactyl. This all-balsa model is covered with silk and dope. 12 pounds, 14 ounces; 105-inch wingspan; Astro Flight 60 motor turning a 13x8 prop; 28 1400mAh cells; JR radio.*



From Hagen, Germany, Jorg Vogelsang won the Best of Show award with his 1/2.2-scale Bleriot II. The completely scratch-built wood model is a replica of the first English aircraft to cross the English Channel. 43 pounds; 175.5-inch wingspan; JR radio; 30x10 prop; homemade 7ci engine.*

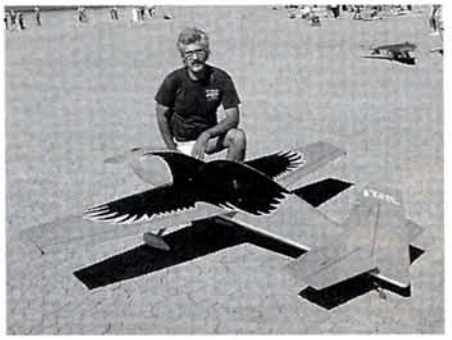
THE 19TH Annual QSAA Fly-In was held near Las Vegas on October 19 to 21, 1995, at Eldorado Dry Lake—a dry lake bed about 10 miles long and 5 miles wide that is the regular QSAA (Quarter Scale Association of America) flying site. The hundreds of entrants from all over the world included 200 registered pilots and 200 unregistered modelers, which made the flight line almost ½ mile long. Cars, trucks and motor homes were parked four and five deep right behind the flight line, and the weather was perfect. About 75 R/C vendors were on hand this year along with thousands of spectators.

Thursday started with a static display show at a nearby 25,000 square-foot parking garage and ended with a well-attended R/C auction at the Samstown Hotel & Casino. Flying was scheduled from 8 a.m. to 5 p.m., except for Sunday, which was set aside for photo-taking. Saturday night was award night, and everyone enjoyed the banquet, which was emceed by QSAA president Warren Cross.

The QSAA Fly-In always attracts many big-name modelers. With such good flying (you can't help but make a good landing at such a large flying site), the auction, a banquet and some of the most beautiful scale models in the world, the QSAA Fly-In is always an exciting event. Mark October 10, 11 and 12, 1996, on your calendar, and make plans for a Las Vegas vacation. It will be worth the trip.

PHOTOS BY BOB BANKA

Bill Gillespie of St. Albert, Canada, won Best Military with his unusual Curtiss-Wright A-12 Shrike. It has flaps, slats, a bomb drop and smoke. 39 pounds; 8-foot, 8-inch wingspan; 6ci engine turning a 3-blade 22x10 prop; JR radio.



Mike Lappert of Riverside, CA, won the Best Finish award with his 38-percent-scale Raven. 35 pounds; 97-inch wingspan; 125cc gas engine turning a 24x16 Zinger prop; Airtronics* radio; Tru-Turn* spinner; D.W. Enterprises kit; foam and fiberglass construction.*

1995 QSAA Winners' Chart

Category	Winner	Model
Best of Show	Joerg Vogelsang	Bleriot XI
Best Multi Engine	Nick Rivaldo	C-47
Best Biplane After 1918	Claude McCullough	Gwinn Aircar
Best Biplane Before1919	Steve Parola	Sopwith Pup
Best Finish	Mike Lappert	Raven
Ed Morgan Memorial	Ken Perkins	Fairchild FC-2W2
Best Military	Bill Gillespie	Curtiss A-12 Shrike
Best Standoff Scale	Bob Gillespie	Cessna 310
Mechanical Achievement	Dale Yaney	RB-35 Northop Flying Wing
Powder Puff	Ruth Sharp	deHavilland Tigermoth
Junior Achievement	Trent Byrd	1930 Fleet Bipe
Best Scratch-Built	Noal Hess	Lockheed Vega 5-C
Best Glider	Vince Lopez	ASW-20
Best Static Display	Willie Gardner	Australian Airtruck
Best Civilian	Dave Lane	Stinson SR-9
Best Electric	Tony Naccarato	Hill Pterodactyl
Best Homebuilt	Sid Tanabe	Avid Mark IV
Best Madera-Style Racer	Bob McClung	P-51D Mustang
Best Jet	Dean Lassek	A-10 Warthog
Best Crash	Walt Moucha	Westley Whirlwind
Marathon of Flight	Hugh O'Connell	Schweitzer SGM 2-37 motor Glider (201 miles on 1/2 gal.)
Longest Traveled	Dr. Michael Hawkins	Bucker BU-180 Student (8,279 miles, Bangkok, Thailand)

Winner of the Ed Morgan Memorial Best of Scale award was Ken Perkins of Lakeside, AZ, with his scratch-built, 1/5-scale Fairchild FC-2W2. The model is a replica of Admiral Byrd's aircraft that was used for photographing and mapping the Antarctic. 30 pounds; 10-foot wingspan; Seidel 9-cylinder radial engine turning a 22x14 Maro prop; Airtronics radio.*

Sid Tanabe of Boise, ID, won the Best Homebuilt award with his 1/3-scale Avid Flyer Mark IV. Construction consists of welded aluminum tubes, and the model is covered with F&M Enterprises' Scale Stits fabric covering and Poly Tone paints. 26 pounds; 96-inch wingspan; Zenoah G-62; 22x8 adjustable prop; Futaba radio.*

Ruth Sharp of Hesperia, CA, won the Powder Puff award with her 1/4-scale Tigermoth. Pilot kit; 17 pounds; 88-inch wingspan; Enya 120 4-stroke turning a Master Airscrew 16x6 prop; Futaba radio.*

Dr. Mike Hawkins came all the way from Bangkok, Thailand, with his scratch-built Bucker Bu 180 Student, and he won the Longest Distance Traveled award for his 8,279 mile trip. 11 pounds, 2 ounces; 100-inch wingspan; Enya 120 FS turning an APC* 14x8 prop; foam wings; fiberglass and balsa construction; Hitec* radio.*

Harry Darrah of Moreno, CA, is shown here with his impressive 1/6-scale P-61 Black Widow (piloted by John Elliott). The 100-pound model is powered by two Quadra 100s turning Zinger 24x14 props. The span is 10 foot, 4 inches, and construction is fiberglass, wood and metal. Three radios with 10 channels are used to control the model.

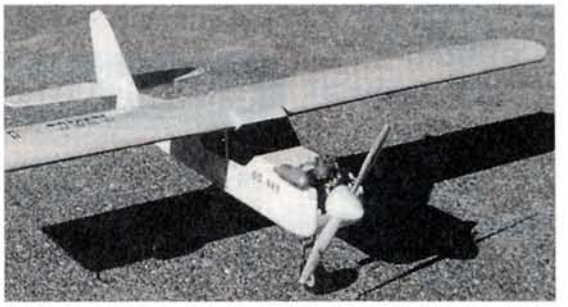
Winner of the best scratch-built model was Noal Hess o Salt Lake City, UT, with his 1/4-scale Lockheed Vega 5-C Winnie Mae. 46 pounds; 123-inch wingspan; Zenoah G-62 Futaba radio; balsa and ply construction with fiberglas cloth; Nelson* System three-paint finish.*

For information on the '96 QSAA Fly-In, contact president Warren Cross at (702) 979-7279.

Scratch-Builders' CORNER

by GEORGE WILSON

THOUGHTS ON WEIGHT AND STRENGTH



The lightweight 5-channel Gulp (a redesign of Bill Winter's Swallow), which is discussed in the article. By altering other designers' plans, you can have unique, one-of-a-kind models without having to do all the design work yourself.

I FEEL honored to be asked to join the group of *Model Airplane News'* authors who write about scratch-building. By way of introduction, I started model building during the "golden age" of aviation—the 1930s. My Dad taught me to build model boats, and I soon got into model airplanes (my first kit cost 5 cents). I progressed through solid scale, rubber-powered, free-flight gas, control-line, R/C seaplanes, scale, sport and especially trainers. It appears that more of my R/C seaplane designs have been published than those of any other designer. My own R/C trainer was a Henry Struck "Seacat," and more than 100 of my articles on models and amateur radio have been published. Many of these have been on building techniques. Most of my models are scratch-designed and -built, and it will be a privilege to share some of the knowledge that I've accumulated over the years.

WHY SCRATCH?

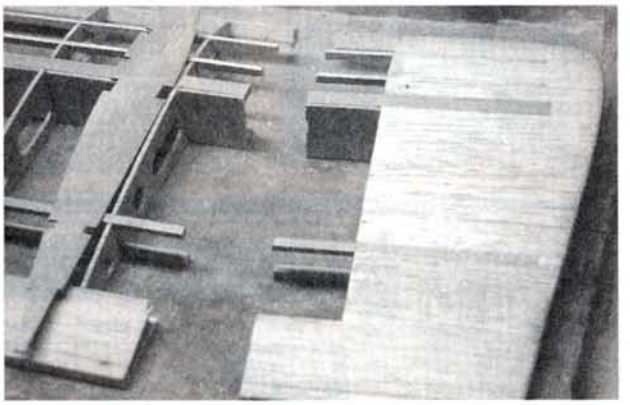
Why scratch-build?—mostly because of the satisfaction of knowing that you contributed to the design and construction techniques that make up the model. Second, scratch-builders save money and can modify other modelers' designs and create totally new ones.

With just a little experience, you'll discover that scratch-building is not difficult, but currently available kits offer a great way to gain experience with materials and building techniques. In fact, the instructions in many kits provide general information that can be applied to other kits and to scratch-building as well.

Once you've been turned on to scratch-building by seeing a magazine article/plan that suits you, or you get the urge to design your own model, you're on your way to participating in one of the best parts of modeling.

WEIGHT AND STRENGTH

Let's talk about two related aspects of model building: weight and strength.

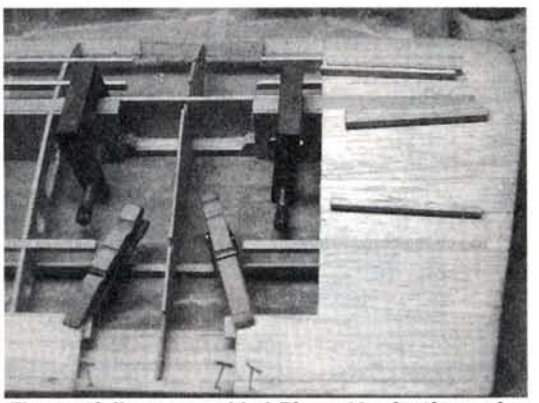


The Ace R/C Bingo 40 wing after it had been severed and before it had been reattached with 3 inches of added span. On the left: the rib that was added later. This is a good way of increasing wing area and reducing wing loading.

More weight requires more power and strength and these, in themselves, increase weight.

It has been said many times that anything will fly if it has a big enough engine—fly, yes, but probably not well. Most models are over-powered. "You can always throttle back," is an often heard excuse for having too much power; on the other hand, almost without exception, light models fly better. Incidentally, beware of smaller-displacement engines that are built on larger-displacement engine frames. A .35 often weighs the same as a .40 that uses the same frame. You might as well buy the .40 and throttle back a bit.

In most models, the powerplant and radio equipment are the major weights—so-called "weight drivers." Once you've selected an engine, you're "locked" into the engine/muffler/propeller and radio weight. On average, a .40-size engine/muffler/prop together average 15 ounces—almost 1 pound. An average radio with four servos, battery and wiring comes in at about 12 ounces. Together, they make up



The partially reassembled Bingo 40 wingtip; a pine spar joiner was used, and "scab" reinforcements ensure strength. Lengthening the wings does not drastically alter most models' looks, but it does improve flight performance.

almost 40 percent of a 5-pound model's weight.

I examined four R/C models to determine their weight distributions. Three were scratch designs (two were mine), and one was Doc Matthews' Bingo .40. See the "Weight Distribution" chart.

WEIGHT DISTRIBUTION

The models cover a wide range of R/C sport and trainer types. In the .40-size models, about 40 percent of the weight is in the engine/radio combination. In the .15-size model, these items account for about 60 percent of the weight. If electric-powered models had been included in the study, the motor/battery/radio weight would have been even greater. It follows that any weight savings must be made in the wing and fuselage.

Observe that the tail contributes relatively little to the weight. This is good design. If nose weight is needed for balance (and it frequently is), it takes at least three times as much nose weight to offset weight in the tail. Strength with minimum weight is achieved by using smart design and building techniques. Materials must have high strength-to-weight ratios and they must be assembled in ways that provide the necessary strength with minimum material.

WEIGHT SAVING

Over the years, we've seen many articles telling how to reduce weight by hollowing out balsa blocks and cutting lightening holes in sheet balsa. When building lightweight rubber- and CO^2-powered models, these techniques are important. Their importance decreases, however, as the ratio of wood weight to the model's total weight decreases. As shown in the chart, this is true of mid-size R/C models.

A sheet of 1/16x3x36-inch average weight balsa (10 pounds/cubic foot) weighs 0.625 ounce. From it, you can cut about eight ribs, each with a 10-inch chord. A 60-inch wing with 3-inch rib spacing would require 22 ribs—about three sheets of 1/16-inch balsa. Allowing for scrap, the ribs' total weight would be about 1½ ounces. Cutting lightening holes would remove 1/3 of the material and save about ½ ounce—about ½ percent in a 5-pound model. Is this a worthwhile (smart) weight savings? I think not. The best way to save weight is by selecting wood carefully and using smart, weight-saving building techniques. In a future column, I'll deal with these and will discuss how to make maximum use of surface, structural and material strengths, and also the strength-to-weight ratios of various woods, covering materials and metals. If we plan for lightness, we can achieve it—without sacrificing strength.

Plan of the month

In a future column, we'll discuss Rich Uravitch's popular OV-10 Bronco and many other Model Airplane News plans; they can all easily be modified to suit your flying skills.

FSP11951—OV-10 Bronco

The North American Rockwell OV-10 Bronco is a simple, scale, small-displacement model that makes a perfect first twin-engine project. If it *has* to, it will also perform well on a single engine, and it's easy to construct, especially if you use the formed-plastic parts available from its designer Rich Uravitch. WS: 52 in.; L: 52 in.; power: (2) .20 to .25 engines or 05 to 15 motors; 4 channels; **LD 2. $14.95**

Weight Distribution

Type/engine	Percentage of total weight						
	Engine	Radio	Fuse	Wing	Gear	Tail	Total wt. (oz.)
Low-wing sport .45	25	19	19	25	10	2	70.8
Low-wing sport .40	24	18	29	22	5	2	89.7
High-wing sport .35	25	19	22	26	6	2	63.3
High-wing trainer .15	29	30	10	18	11	2	35.7

KIT BASHING

The term "kit bashing" is popular these days, but most scratch-builders have always considered kit bashing a way of life. My Ace* Bingo 40 has 6 inches of added wingspan, hollow wingtips and lightened tail surfaces. The photos show how the wingtips were cut off between the ribs and re-attached with 3 inches of added span and an added rib on each wing. This is a good way to increase wing area and reduce wing loading. Most of the joints were reinforced with an extra layer wood known as a "scab." The spar joiner is a piece of 1/16-inch-thick pine sheet. In the finished model, the surgery is visible through the translucent, lightweight Coverite* Micafilm covering.

Other photos this month include one of my Gulp, which is a major (almost complete) redesign of Bill Winter's Swallow (March '94 *Flying Models*). The tail surfaces went on the drafting board first and are quite similar to those on Bill's Swallow. From there on, there's little similarity. The Gulp is a 5-channel airplane that has very effective flaps. It weighs less than 4 pounds and does very impressive maneuvers with its .35 engine. Its lightness is the result of careful design; some of its features will be discussed in a future column.

If you have questions or comments regarding scratch-building, please write to me c/o Scratch-Builders' Corner, *Model Airplane News,* 251 Danbury Rd., Wilton, CT 06897-3035.

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

MODEL AIRPLANE NEWS

FIELD & BENCH REVIEW

An electric, low-wing aerobat

Flame

HOBBY LOBBY INTL.

by VIC OLIVETT

WHEN CHRIS Chianelli asked me to do a review of the Hobby Lobby* Flame, all I could imagine was a high-wing floater. Boy, was I wrong. This 66-inch, low-wing, aerobatic electric is a fantastic flier, and it's quite easy to build.

The lightweight Flame is designed around a very thin, modified E193 airfoil with turbulator spars. The power system recommended for this plane is a Mega S5 or S7; an 11x7 Graupner non-folding prop; two 8-cell, 1700 SCR packs; and a Graupner Power Mos 45 speed control. All of these components are available from Hobby Lobby. The Flame can also be powered with a .40-size engine.

THE KIT

The all-balsa and plywood parts are cleanly cut and light. The ribs are die-cut, and the fuselage is the typical box construction. The plans are accurate and clear, and the instruction sheet is easy to understand.

As I unrolled the plans, I was amazed at the size of the Flame. I couldn't believe that this plane would take off from a grass runway with only an electric motor for power. Anxious to check out the final results, I immediately went to work.

CONSTRUCTION

• **Wing.** Before you start construction, mark all the die-cut parts before you remove them from the sheets. They can be identified from the instruction sheet. Also, trial-fit everything before gluing. I used Zap* and epoxy for the entire building process.

Because the instructions for building the wing are well-done, I'll just cover the important aspects of wing construction. After you've made the two wing halves, glue the center ribs (W-1) into place. Shim each wingtip ½ inch, and make sure the center ribs are set in place 90 degrees to the bench. When you're satisfied with this alignment, zap them into place. This angle is important because it sets the dihedral angle when you join the two wing halves later. Trial-fit and epoxy the landing-gear blocks in place. The short, 1-inch blocks have to be trimmed to fit, and they should extend to the top of the rib.

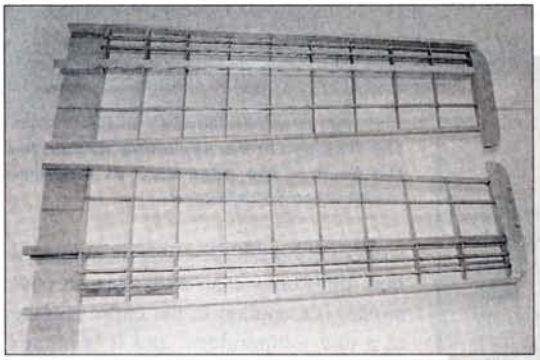
When the wing halves are complete and ready to be joined, shim each tip ½ inch (not 1 inch as indicated in the instructions), and glue them together with 30-minute epoxy. Use tape to hold the halves together until the epoxy has cured. To fit the aileron servo properly, cut an opening in the center of the wing in the W-1 ribs. The sheer webs must be trimmed, and great care should be taken to keep the wing as straight as possible when the webs are glued in place. Sheet the top center section, and cut a hole for the servo; then glue the servo mounts. Reinforce the center section with some glass cloth and thin Zap.

• **Tail feathers.** The stab and fin are built directly over the plans out of the ¼x½-inch stick stock. The rudder and the elevators are pre-shaped and have to be rounded in the front for the hinge point and tapered toward the rear.

Place the elevators over the plans, mark the location for the 3/32-inch wire joiner, and drill the holes. Install the six hinges, but don't glue them until after the parts have been covered.

This 66-inch, low-wing, aerobatic electric is a fantastic flier, and it's quite easy to build.

• **Fuselage.** The fuselage is the standard box construction. Nothing too difficult, but there are a few things to keep in mind. Remember, this fuse will be holding a lot of weight (mainly the batteries), and it should be built with strength in mind. Make sure that you build a right and left side for the fuse, and mark both sides of the fuse for the formers. Formers F2 and F3 are glued together and then glued to one fuse side along with F4. When the formers are glued into place, use a square to achieve the 90-degree angle between the former and the fuse side. Align and square the other fuse side in place, and when you're satisfied with the placement, use Zap to secure it.

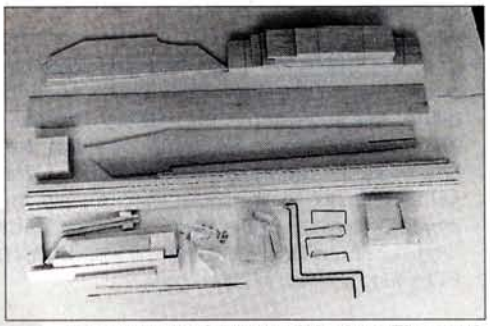


The completed wing halves ready to be joined. Make sure to raise each wingtip only ½ inch rather than the 1 inch that's indicated in the instruction manual.

Bevel the inside pieces at the rear of the fuse so that when they're pulled together for alignment, the very rear portion of the fuselage will be only ¼ inch wide.

• **Motor area.** This requires a different type of construction than normal. The motor is mounted with three machine screws through the plywood nose ring. The triangle stock on the forward sides of the fuse should be cut and sanded so they mate well to the nose ring. When the nose area has been finished, the front portion should be block-sanded for 0 degree motor thrust angle both side-to-side and up-and-down. Then glue on nose piece F1.

• **Wing and tail mounting.** Test-fit the wing, and drill the ¼-inch holes through the F2/F3 formers and into the reinforced wing area. Slide the ¼-inch dowel into the wing for a test fit, but don't glue it until after the wing has been covered. Align the wing, and drill the rear mounting holes. Drill the first hole; then, to keep the wing from moving, leave that drill in place, and use a second drill bit to drill the other hole. Remove the wing, and enlarge the fuse holes for the T-nuts. Now you can sheet the bottom of the wing. Align the fin and the stab, and glue them in place.



The contents right out of the box. The good-quality wood and hardware made this kit a pleasure to build.

SPECIFICATIONS

Name: Flame

Manufacturer: Hobby Lobby Intl.

Type: aerobatic electric

Wingspan: 66 in.

Length: 48 in.

Wing area: 682 sq. in.

Wing loading: 21.5 oz. per sq. ft.

Airfoil: E193 (modified) semisymmetrical

Weight: 102 oz.

Radio req'd: 4 channel (aileron, elevator, rudder, throttle)

Radio used: JR F-400

Motor used: Mega S7, w/ 2 8-cell 1400mAh SCR battery packs

Prop used: Graupner 11x7

Motor control: Graupner Power Mos 45 (for JR)

Price: $69.70 (not including motor, batteries, or speed controller)

Features: all-balsa and plywood kit; complete hardware package; rolled plans; instruction manual; easy to build (although it isn't a beginners' kit).

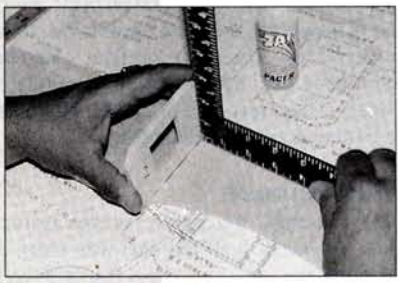
Comments: This was my first electric plane, and I was anticipating just another floating electric. The Flame doesn't even come close to fitting that description. It's a fast, aerobatic electric that flies just like a sport-type, .40-size, low-wing plane. It jumps off of the ground on takeoff, and it's a real pleasure to fly. I don't recommend the Flame for a beginner, but if you're an intermediate to advanced pilot and would like to try an electric, here's your plane.

Hits

- Quality of the wood and hardware is excellent.
- Plans are well-drawn and very clear.
- Goes together quickly.
- Great aerobatic performer.

Misses

- Instructions are a little too abbreviated.
- No photos for referencing.



Use a square to ensure that the formers are attached 90 degrees to the fuselage sides.

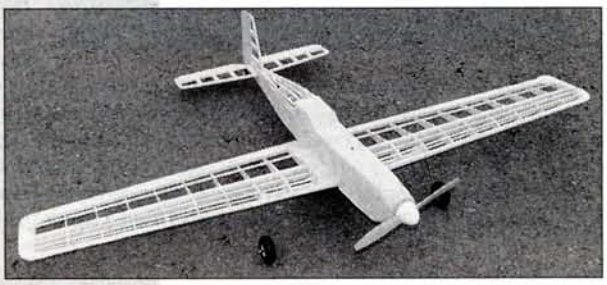
WIRING

The SCR batteries are very powerful, so be careful when you wire the power system together. The Flame has more than enough room for the equipment needed, and the plans will give you the location for the components. The batteries are mounted over the wing, and they can be moved forward or aft to adjust the CG. To connect the system, use a good-quality solder and wire.

Hobby Lobby recommends a Graupner 11x7 prop for this project. I added a power switch to the power system and used a 25A, single-pole, single-throw switch from Radio Shack. After you see the power of the Mega S7 motor, I'm sure you'll want to do the same.

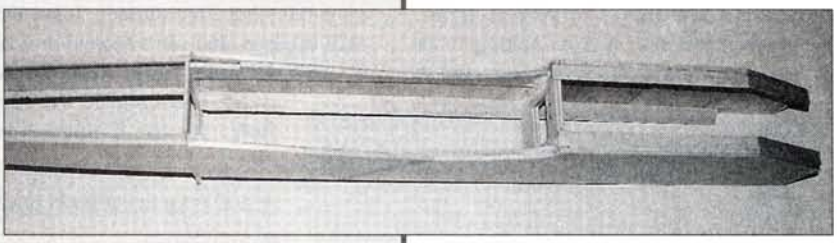
FINISHING

To cover the Flame, I used Hobby Lobby's Oracover iron-on film, which



I've been a glow-powered modeler for many years, and because this was my first electric-powered plane, I had the feeling that I was forgetting something on my way to the field. Let's see: I have the plane, the transmitter, the battery charger—aha!—no fuel can or fuel pump, no heavy field box, no starter battery or glow-plug driver. I could get used to not lugging those items around anymore. On arriving at the field, the JR radio was range-checked with the motor off and then on. Everything seemed to be in order.

Try out the Flame—now you'll be able to tear up the sky quietly in places where combustion-engine planes wouldn't be able to fly.



The fuselage in the beginning stages. Set the front of the nose area at 0-degree thrust when you shape it.

FLIGHT PERFORMANCE

• Takeoff and landing

The power of the Mega S7 motor is incredible. During the taxi-to-takeoff position, the Mega S7, combined with the Graupner 11x7, pulled the plane along the ground effortlessly. On takeoff, the Flame was in the air in about 50 feet and climbing for altitude. I didn't even have to think about the takeoff; I just advanced the throttle stick, steered it straight with the rudder and up it went. The takeoff process presents no problems, but it does happen quickly; so be prepared.

Once the plane was at a comfortable altitude, I throttled back to ⅓ power, trimmed the plane with right aileron and up-trim and flew the first flight with a few gentle turns and some flybys. Subsequent flights had a little more "juice" throttled in and the Flame definitely was moving faster and enjoying every minute of flight.

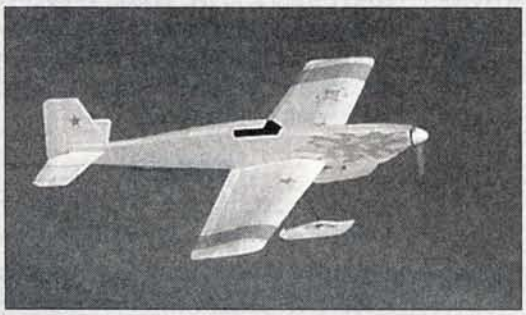
Landing the Flame is quite easy; just line up with the runway, kill the motor, glide in and flare for touchdown. The plane will float a little during the glide, so you'll have to plan your glide path accordingly. If you underestimate the glide, just start the motor again (¼ power), and proceed with the landing. As with all electrics, save a little battery power for the landing.

• Low-speed performance

At low speeds (about ¼ throttle), the Flame handles extremely well, and the stall speed is very low. Recovery from the stall was easy; add a little power, and fly out of it. During the low-speed stall, the Flame showed no tendency to drop a wing. Low-speed turns were gentle and stable and needed only a hint of power to maintain altitude if the plane's speed became too slow. Energy management for the low-speed flying resulted in flights of close to 7 minutes.

• High-speed performance

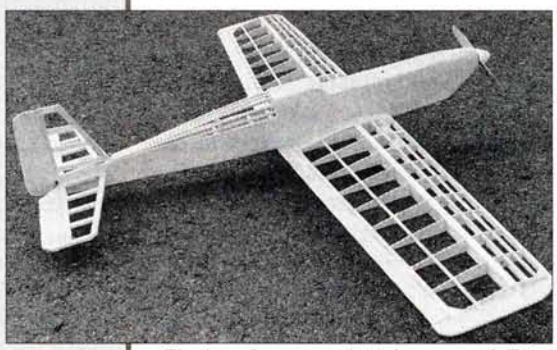
With the Mega S7, the Flame has the power of a .40-size sport model, and it will fly just as well as any plane in that category. Under full power, it has a fast climb rate, so be prepared to gain altitude quickly. To achieve a power-on stall, I had to back off the throttle a little and, just like in the low-speed stall, recovery was easy. Add some power, and fly out of it. At high speeds, the Flame tracked straight as an arrow, and there were no signs of fish-tailing. Flying at full throttle cut the flight time to 4 minutes.



• Aerobatics

In order to get a faster roll rate, I had to increase the aileron throw. This adjustment produced a roll rate of moderate speed, and the rolls were straight and true. Loops were smooth and showed no signs of rolling out of their track during the pull-up. The Flame loves inverted flight and doesn't really know if it is inverted or not. Hammerheads, stall turns, wingovers and Chandelles were easily accomplished with the power at ⅔ throttle and kicking the rudder at the appropriate time. To start a spin, the Flame needed a slight burst of power, along with the standard left rudder, up-elevator and left aileron. Because there's no sheeting on the wing, I did notice that the wings tended to twist slightly under a heavy G-load. So be careful during violent maneuvers.

works very well. Oracover is applied a little differently than most iron-on coverings. It's applied to the entire surface at a low temperature, and it becomes tight when the temperature is increased. This technique removes wrinkles and provides a good-looking, durable finish.



The bare bones ready to be covered. Total flying weight is 102 ounces (6.4 pounds).

THE END RESULTS

The Flame is a good-looking, large plane that begs to be flown. Test runs of the motor proved it to be extremely powerful, so be careful handling this model when the motor is running.

The Flame goes together quickly, and it's easy to build, so you'll be at the field in no time with your new electric plane. And, if you think that only gas-powered planes give you aerobatic performance, try out the Flame, and think again. Now you'll be able to tear up the sky quietly in places where combustion-engine planes wouldn't be able to fly. Enjoy a fine product.

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

About the author

Vic Olivett has been an avid modeler for many years and has been writing for Model Airplane News since the late '80s. He also has a private pilot's license.

Club of the MONTH

TRCC

c/o Chuck Brooks,
6738 E. Scarlett St., Tucson, AZ 85710

In Arizona, the Tucson Radio Control Club (TRCC) is busy keeping R/C flying alive and well. Their yearly activities include events such as: an IMAC competition, a fun fly, Wings Over the Desert, a July 4th family picnic and their Barnstormer Airshow, which gives static displays and flight demos at various schools. TRCC must be generating some enthusiasm because their open membership is bursting at the seams. They are trying to cap the membership at 200 with no limit to juniors. This is a tough, but sometimes necessary, decision that many R/C clubs face.

At each monthly meeting, there are several awards and prizes given out: pilot upgrades, grab bags, raffles and something we'd all like to avoid—the SAD patch of the month. They also introduce guests and prospective members and have a show-and-tell competition. Their monthly newsletter contains safety reminders, technical information, contest results, funny cartoons and some amusing quotes.

TRCC is contributing to the growth of this wonderful sport. Congratulations; your two complimentary subscriptions to *Model Airplane News* are on their way.

MODEL AIRPLANE NEWS

HOW TO

Designs to enhance performance

High-lift devices & drag reduction

by ANDY LENNON

HIGH-LIFT DEVICES (HLDs) on a model specifically designed to take advantage of the substantial lift and drag increase they provide, coupled with good drag reduction techniques, will result in smaller lighter, more nimble airplanes, with a greater range of speeds, from stall to top speed. Their appearance will be sleek—very similar to today's full-scale planes—yet they will be sturdy and capable of sustaining high-G loads of centrifugal force in their maneuvers.

The home-built movement, in cooperation with the Experimental Aircraft Association (EAA), has developed many superb full-scale, single-engine airplanes of composite construction. They have excellent performance on relatively low horsepower. These are the "Lancairs," "Glassairs," "Swift Lightning" and "Pulsars," to name a few. Their outstanding performance is due to good design and careful drag reduction. All have flaps to permit acceptable landing speeds. In contrast, most current models are reminiscent of the high-drag aircraft of the thirties.

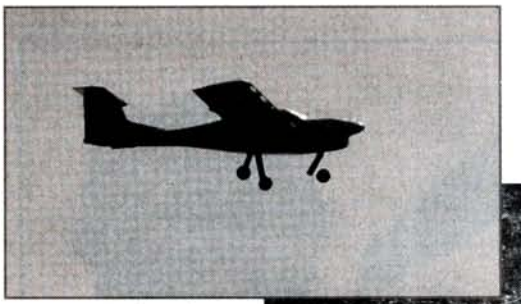


Photo 1. The Crow in level flight.

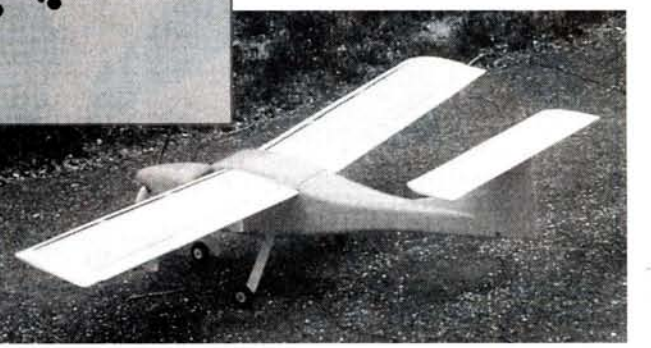


Photo 2. The Crow at rest. Note the wing's high-lift devices (HLDs).

Very few modelers take advantage of these two factors: HLDs and drag reduction. Flaps are limited largely to scale models of aircraft so equipped. Hopefully, this article will persuade modelers to incorporate flaps and drag reduction in new and innovative designs; the benefits justify the effort.

STALL AND LANDING SPEED

Landing speeds have not had much discussion in the model airplane press, but are a major consideration in full-scale design. Landing speeds are a function of the model's stalling speed, which in turn, depends on three factors: weight, wing area and the airfoil's maximum lift capacity. Weight and wing area are combined in the form of "wing loading" in ounces per square foot of wing area.

Refer to Figure 1: at a wing loading of 16 oz./sq. ft. and wing maximum lift coefficient of 1.00, the stall speed is 20mph. At a wing loading of 40 oz./sq. ft., stall speed increases to 33mph. If the wing maximum lift coefficient could be increased with the high-lift devices to 2.40, the stall speed would still be 20mph at 40 oz./sq. ft.

U.S. Federal Air Regulations (FARs) specify a stall speed of not more than 60 knots (or 69mph) for aircraft weighing less than 12,500 pounds of takeoff gross weight. Sixty-nine miles per hour is as fast as few models can fly at top speed! Most light, single-engine, full-scale aircraft stall, flaps extended 40 degrees, power-off and at gross weight at about 50mph. This is still too high for model aircraft. A "scale" speed is needed! In "Scale Realism" (*Model Airplane*

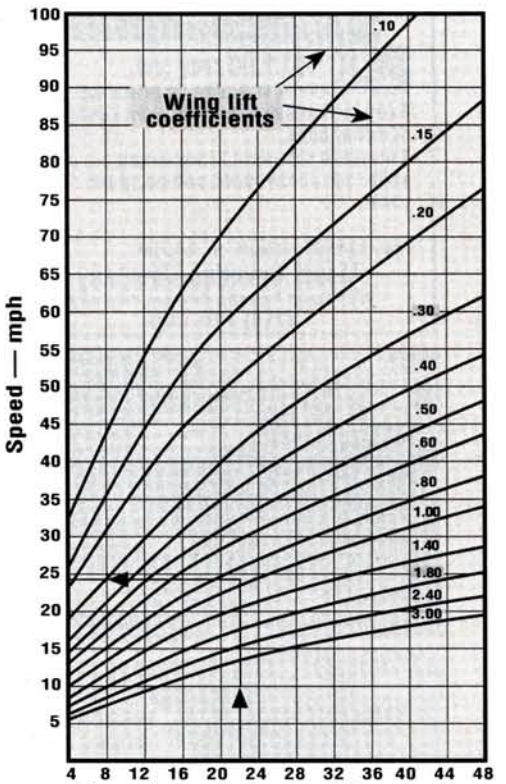


Figure 1. Graph showing determination of wing loading, lift and speed.

Specifications	Model A	Model B
Wing area (sq. in.)	750	500
Fueled weight (oz.)	96	88
Wing planform	Constant chord	Constant chord
Aspect ratio	6	6
Span (in.)	67	54.75
Chord (in.)	11.2	9.13
Wing loading (oz./sq. ft.)	18.4	25.3
Wing airfoil	E 197	E197
Tail airfoil	Flat	E168
Airfoil C_L max	1.17	1.8 (flaps at 40°)
Power (cid)	0.46	0.46
Power loadings (oz./cid)	208.7	191.3
Propeller	11x6	10x9
Rpm	11,000	11,000
Est. max speed (mph)	75	100
Est. stall speed (mph)	19.5	18
Servos	4	5

News, September 1993; page 61), Kent Walters' suggestion that scale speeds be calculated using "the square root of the scale factor" is explained. This is a very sensible suggestion. Most .40- to .50-powered models will be about 1/6 or 1/7 of the size of their big brothers. The square roots of these scale values are $\sqrt{1/6} = \sqrt{0.1666}$ or 0.408 and $\sqrt{1/7} = \sqrt{0.1428}$ or 0.378. Multiplying 50mph by these numbers: 50 x 0.408 = 20mph and 50 x 0.378 = 18.9 mph. A model's stall speed of 20mph seems reasonable. FAR no. 23 stipulates that approach speeds should be 1.3 times the stall speed, or 26mph. Twenty-five to 30mph are sensible speeds—fast enough for good control response, but slow enough for good pilot response.

In the absence of an air-speed indicator, it is not possible to judge the model's exact speed. However, if the glide is too flat and

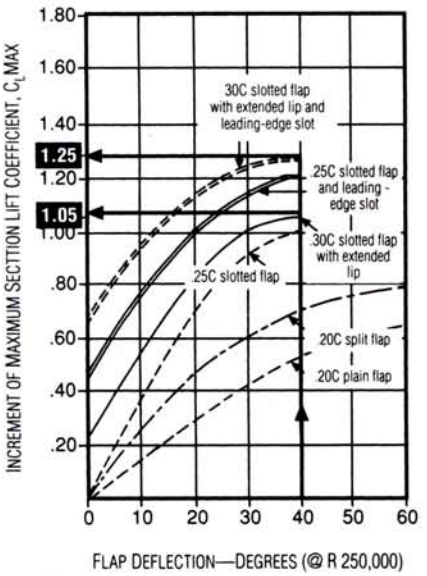


Figure 3. Increments of maximum lift caused by flaps and leading-edge slots.

slow, most models will alert their pilots by gently stalling and nosing down (a signal to apply a bit of nose-down elevator trim).

A model with slotted flaps flying on a windy day lands into the wind *flaps up* for more air speed with better penetration and control response. The higher wing loadings are less affected by gusts, and the touchdown speed is reduced by the wind's velocity. An unflapped model, with lower wing loading, is easily disturbed by gusts, making landings more difficult.

MAXIMUM LIFT COEFFICIENT—C_L MAX

To determine the C_L max for an unflapped wing, a simple and reasonably accurate method is to use the C_L max of the wing's airfoil. For the E197 shown in Figure 2, this is 1.17. For a wing with partial span slotted flaps of 30 percent of the wing's chord in width, the flapped portion will produce an additional lift coefficient of 1.05 at 40 degrees deflection, as shown in Figure 3.

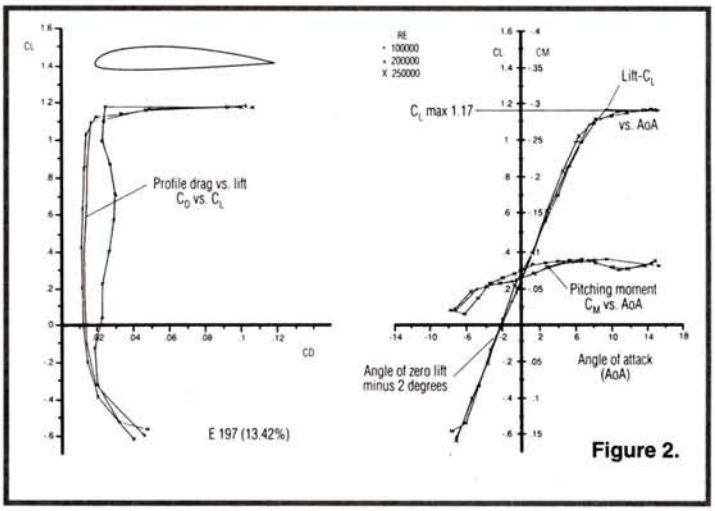


Figure 2.

Using the E 197 again, the flapped portion provides 1.17 + 1.05, or a C_L max of 2.22. The unflapped area has a C_L max of 1.17. To obtain the average C_L max, proceed as follows:

Unflapped area (sq. in.) x 1.17 = x
Flapped area (sq. in.) x 2.22 = y
Total area = x + y

Divide $\frac{x + y}{\text{total area}}$ = average C_L max

That portion of the wing in or on the fuselage is considered as unflapped wing area.

Obviously, a tapered wing of equal area and aspect ratio, compared with a constant-chord wing, and the same length of slotted flap, would have a higher C_L max, since a greater portion is "flapped" (see Figure 4). To determine the stall speed, flaps down, refer to Figure 1; knowing the model's loading and C_L max, the stall speed is read off the vertical left-hand scale for sea-level conditions; otherwise, use this formula (WA = wing area; DF = density factor):

4. Stall speed mph = $\sqrt{\frac{\text{weight (oz.)} \times 3519}{C_L \text{ max} \times \text{WA (sq. in.)} \times \text{DF}}}$

The density factor at sea level is 1.00; at 5,000 feet of altitude, it's 0.8616; and at 10,000 feet it's 0.7384. This is one variation of the lift formula; involved are four factors, weight, wing area, speed and lift coefficient. Knowing three; the fourth is easily calculated as follows:

1. Lift (oz.) = $\frac{C_L \times \text{speed}^2\text{(mph)} \times \text{WA (sq. in.)} \times \text{DF}}{3519}$

2. WA (sq. in.) = $\frac{\text{Lift (oz.)} \times 3519}{C_L \times \text{speed}^2\text{(mph)} \times \text{DF}}$

3. Lift coeff = $\frac{\text{Lift (oz.)} \times 3519}{\text{Speed}^2\text{(mph)} \times \text{WA (sq. in.)} \times \text{DF}}$

4. Stall speed (mph) is shown above.

DESIGN COMPARISONS

To illustrate the advantages of high-lift devices and drag reduction, the specifications of two models (A and B) are outlined—both designed for stall speeds close to 20mph. Both are powered by .46cid engines and have the same control unit, but model B has an extra (fifth) servo for flap actuation.

Photo 3. Flaps down, the Crow is descending.

Model A is typical of many models seen at any flying field; exposed engine; small spinner (or none); bare music-wire landing gear leg; big fat wheels, flat windshield; square cross-section fuselage; dowels; and rubber-band wing hold-downs; flat balsa tail surfaces; exposed control horns; lots of "built-in headwinds" (beneficial for steepening the model's glide and making landings easy). It has no flaps. The wing is D-spar construction, plastic-film-covered; the fuselage is lite-ply; and the tail surfaces are 1/4-inch balsa sheet.

Model B has a ducted cowl (reference 12; see list at the end of this article) enclosing the engine; a large spinner; landing-gear leg fairings; small streamlined wheels; concealed wing hold-downs; balsa-sheeted, stressed-skin structure with a film overlay (reference 6), streamlined windshield; and minimum exposure of control horns. It has slotted flaps, 30 percent of the wing

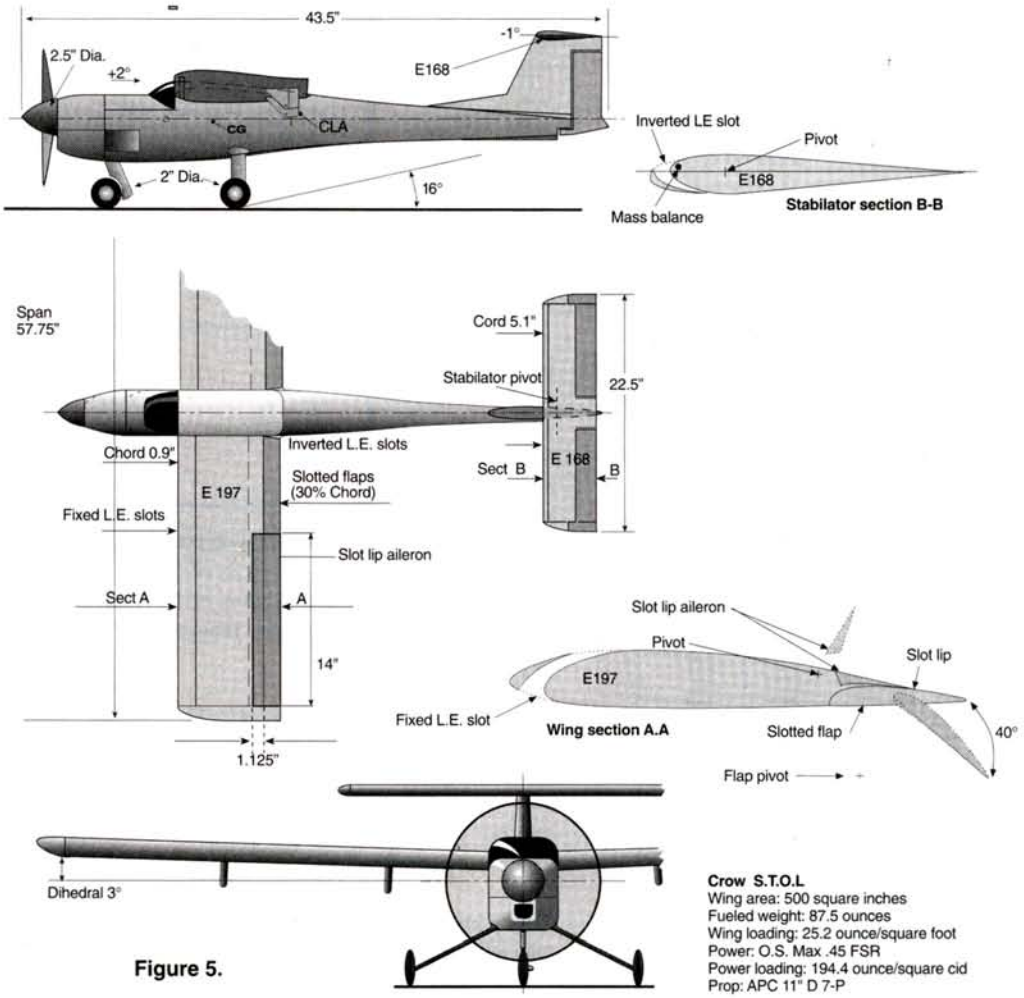
chord in width and 60 percent of the semi-span in length.

Because of its sleek, low-drag design, similar to the Swift's (reference no. 17), it is capable of high speeds. Mass balancing of ailerons, elevator and rudder is incorporated to avoid flutter that could be very damaging.

WEIGHT ANALYSIS

Look at the "Specifications" chart. The power and control units and landing gear of model A weigh 45 ounces (reference no. 9) leaving 51 ounces for the structure of fuselage, wing and tail surfaces. Model B's wing area is two-thirds that of model A; it is reasonable to estimate that model B's *structural* weight would be two-thirds of model A's, or a weight reduction of 17 ounces.

Model B's weight would, however, be increased by the ducted cowl, large spinner, landing-gear leg fairings, full balsa stressed skins, flaps plus their servo and linkage, mass balancing of control surfaces and a 700mAh battery replacing the usual onboard unit of 500mAh. This is estimated to add 9 ounces, leaving 8 ounces, reducing model B's weight to 88 ounces. The author's Crow (Figure 5 and photos 1, 2 and 3) at 500 square inches of wing area, grossed 87.5 ounces, confirming model B's estimated weight.



Crow S.T.O.L
Wing area: 500 square inches
Fueled weight: 87.5 ounces
Wing loading: 25.2 ounce/square foot
Power: O.S. Max .45 FSR
Power loading: 194.4 ounce/square cid
Prop: APC 11" D 7-P

Figure 5.

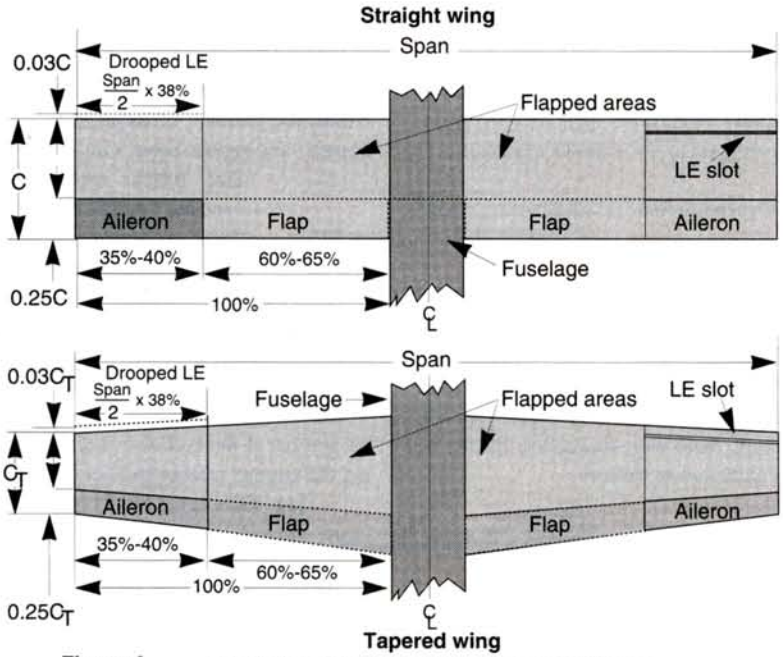


Figure 4. **Desirable flap proportions for straight-wing and tapered-wing designs.**

As for model A, the author's Osprey had a wing area of 768 square inches and weighed 113 ounces It had slotted flaps, six servos, a ducted engine cowl and heavy landing gear weighing 14.5 ounces The fuselage was heavily reinforced for use with twin floats. The fuselage, wing and tail surfaces were not fully balsa-sheet-covered. By comparison, model A's fueled weight of 96 ounces, for 750 square inches of wing area is conservative.

• **Drag comparison.** At 70mph, model B's wing would have 4 ounces less profile and induced drag than model A's wing; but that's not all! The engine cowl, spinner, shorter rounded fuselage (Figure 5), smaller tail surfaces, landing-gear leg fairings and small streamlined wheels, the smoother overall surfaces and absence of dowels and rubber bands holding the wing are conservatively estimated to reduce drag by a further 8 ounces (at 70mph) for a total drag reduction of 12 ounces, permitting a higher top speed for model B. This is confirmed by experience with the author's previous designs (references 13 through 17).

• **Takeoffs.** Assuming rotation at liftoff to be 8 degrees angle of attack, unflapped model A would become airborne at 24mph. Model B, flaps extended to 20 degrees and similarly rotated to 8 degrees, would be airborne at 20mph with a shorter takeoff and steeper climb, flaps still extended. With its lower weight-to-power ratio (power loading) of 191.3 oz./cid, model B's lower drag would permit sustained vertical climb.

Next month, we'll conclude our discussion of high-lift devices with some information on flying flapped models.

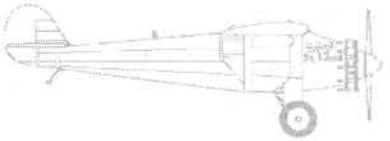
References—Model Airplane News articles:

1. *NASA Safewing—June 1990.*
2. *Design for Flaps—October and November, 1991.*
3. *Reducing Drag—January, February and March, 1992.*
4. *Airfoil Selection—May and June, 1992.*
5. *Wing-Loading Design—August, 1992.*
6. *Stressed-Skin Design—September and October, 1992.*
7. *Propeller Selection—November and December, 1992.*
8. *Wing Design—January, February and March, 1993.*
9. *The Balancing Act—May, 1993.*
10. *Landing-Gear Design—March and June, 1994.*
11. *Speed Estimating—February, 1994.*
12. *Ducted-Cowl Design—August and September, 1994.*

Model Airplane News construction articles:

13. *Crane—March and April, 1983.*
14. *Gull—July, 1984.*
15. *Sea Hawk—October, 1992.*
16. *Swift—September, 1993.*
17. *Dove—November, 1994.*
18. *Wild Goose—January 1996*

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*



Make your sanctuary comfortable and functional

Organize Your Workshop

MODEL AIRPLANE NEWS HOW TO

by JIM SANDQUIST

IT SEEMS THAT the fastest-growing segment of the R/C hobby is building large-scale aircraft. Even if you aren't into large, gasoline-powered airplanes, you might enjoy building a 1.20-size airplane. So, what's stopping you from stepping up to the plate? Is it that your workshop is too small, or that you don't have the tools to accomplish the task? If you're hesitant because you fear the hangar rash that results from turning around in a small space, maybe I can help you.

Right: On the left, the planes are stacked floor to ceiling. The pegboard stores transmitters, and there's a power supply above them for convenient charging.

THE PROBLEM

In 1991, I bought a ¼-scale Stearman. The plane had two 8-foot wings and a 7-foot fuselage. It was obvious that I had to make better use of my work space. My 9x13-foot shop is probably similar to many of yours. But by carefully planning how to use space, I was able to store a ¼-scale Stearman, a ⅓-scale Extra 300S, a ¼-scale Stinson L-5 and a ⅕-scale P-51—not to mention all my tools, paints, workbench, etc.! I do admit that I seldom have enough room to fully assemble and rig wings. But the family room is adjacent to my shop, so when I have to fit wings to the fuselage, balance the aircraft, or work on some other major assembly step, I head for the family room. With a little patience on the part of my wife, I can accomplish my work without much disruption.

The main work area: tools are easily accessible; power strips have plenty of outlets; and the cabinet on the wall holds a TV and VCR. Under the far end of the counter, you can just see the air compressor.

THE SOLUTIONS

First, I assembled an unconventional workbench. Instead of using legs to support the bench top, I placed a couple of 30-inch bases on the floor and tied the bench top to them and to the wall. This allowed me to use the space under the bench more efficiently. The bench top is ¾-inch particle board that has a white Formica™ top, which helps to reflect light and brighten the room. It's 32 inches wide—more than enough space for any ¼-scale model. When I need to build a wing or pin things down, I place a 24x48-inch piece of Builtrite board on top of it.

Above my bench, I have a pegboard that reaches to the ceiling. It keeps all my most-needed tools at my fingertips. I have another pegboard that holds my radio transmitters. So that I can do some painting in my shop, I installed a medium-size fan to vent vapors.

Under the bench, I keep a rolling, machinist-type toolbox in which I store most of my hand tools. Also under the bench are my vacuum, drill press, belt sander, bench grinder, scroll saw, band saw and air compressor. Because there is limited floor space, all my power tools are "tabletop," and I put them on the bench only when I absolutely have to. Just below the underside of the bench top is a shelf on which I store wood.

Throw down an inexpensive runner to help minimize foot fatigue, and you'll have everything you need!

TOOLS

Let's talk about some tools that are indispensable to every shop. At one time or another, every modeler has bought the latest and greatest tool, only to have it sit in a drawer. There are lots of valuable tools, but let's take a look at a couple of "must-haves."

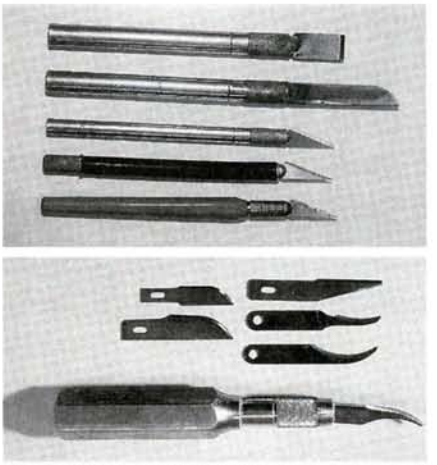
This family of Dremel tools and accessories is a mainstay. Each of these tools has a specific function.

• **Dremel tools.** This company has been making power hand tools for modelers for many years. For my first three years modeling, I did not have one. Buying one just always fell low on the priority list. What a mistake! Today Dremel tools are probably the most often-used tools in my shop. I own the cordless Freewheeler, cordless MiniMite and the variable speed model 595. I really like the convenience of the cordless models. The 2-speed Freewheeler model 850 is generally the first Dremel I grab, however, there are times when the flexibility and power of the model 595 variable speed tool is hard to beat. A slide switch control gives me complete speed control from 5,000 to 30,000rpm. The MiniMite has very low rpm and is great for cutting plastics, polishing and final-shaping wood when the job requires greater control.

Dremel makes a wide variety of tools for cutting and shaping wood, metal, plastics and fiberglass. Companies such as Robart* also offer some tools that work with the Dremel motor tools. Robart also has a right-angle attachment for many Dremel tools that allows you to get into tight spaces. If you don't have one of these in your inventory, put it at the top of your shopping list!

• **X-Acto tools.** Every modeler has a no. 11 X-Acto blade and handle in his shop, but you may not know that there are many other useful blades and accessories. I have a variety of handles for different applications. The standard round handle for the no. 11 blade is great, but the other handles with the anti-roll design are also very useful. When I carve or shape wood, the medium-size handles work a bit better. The large handle is not made just for the saw blades; it works very well with any of the wood-carving blades that are available. These wood-carving blades make short work of carving balsa-block nose areas and wheel pants.

Another must-have cutting tool is the saw blade. Saw blades generally come in ½- and 1-inch versions. The ½-inch blade

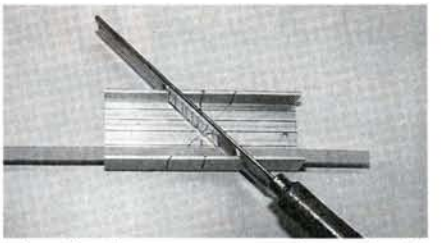


Top: a wide variety of handles, including anti-roll handles (right), is available. Above: a large handle and wood-cutting blades are excellent for shaping balsa block.

is a little easier to control, and the 1-inch blade works well in the tabletop miter box. With the miter box, it is quite easy to get consistent, clean cuts. If you have not acquired a power saw, this tool will help you make good joints for gluing.

• **Cutting mats.** Self-healing cutting mats are a nice accessory. Not only will they protect your bench from inadvertent cuts, but they will also prolong the life of your blades. Most of the mats I've seen are marked in inches, which can be helpful when you cut MonoKote to size for covering. These mats are available in many sizes. I have a large 24x36-inch mat and a smaller 8x5-inch mat, which is very portable and useful for cutting smaller sticks. These mats are available at many hobby shops and at most fabric stores.

• **Rulers.** A variety of rulers is a must. Although I never learned the metric system, I like using metric rulers. They are more accurate and somewhat easier to read. I have both flexible and rigid rulers. It's nice to be able to wrap a ruler around the fuselage and get a precise measurement. One ruler I recently received is the Rule Bender by TAGS*. This 10 mil Lexan ruler is available in 12- and 18-inch versions, and it's totally flexible. Accuracy is plus or minus .005 inch, it's very easy to

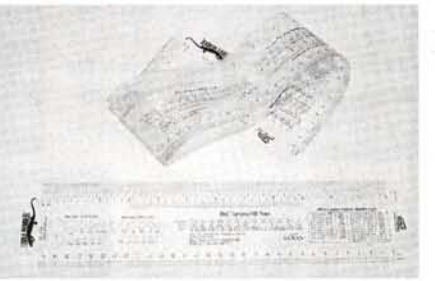


The miter box accessory works great with the 1-inch saw.

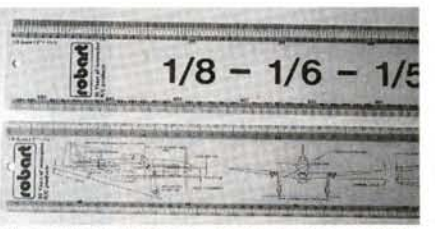
read, and it has many useful model references on it. It costs $5.95 or $7.95 and comes with a lifetime guarantee!

For you scale buffs, you must order the Robart Modelers Scale *today*! This ruler is marked in ⅛, 1/6, ⅕ and ¼ scale. All the conversions have been done! The markings are marked off in highly accurate ¼-inch measurements for the scale you are working in.

There's no doubt that sufficient workshop space and the right tools make the job easier. If you organize your space efficiently and stock it with the proper tools, the



The Rule Bender from TAGS is a highly accurate, completely flexible, Lexan ruler that no shop should be without!



The Robart Modelers Scale makes conversion for scale projects as simple as reading a ruler.

An assortment of rulers makes the job easier.

building portion of the hobby will be more fun for you! So, the next time you venture into your shop, step back and see where the improvements can be made. Have fun!

** Addresses are listed alphabetically in the Index of Manufacturers on page 139.* ✦

Center ON LIFT

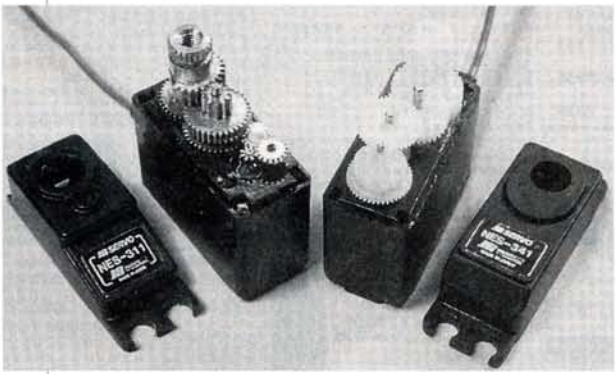
by MIKE LACHOWSKI

METAL-GEAR SERVOS AND AIRFOIL DESIGNS

LAST MONTH, I talked about picking an airfoil from a pilot's point of view. This month, I have some information on servo maintenance and on metal-gear servos, for those not theoretically inclined. I'd also like to continue our airfoil discussion with a little information about the terminology used by airfoil designers. Finally, see the sidebar for tip no. 2 on how to hone your skill in handling thermals.

METAL-GEAR SERVO CHECKUP

Flap servos need to be rugged, and for just this reason, you may have selected a metal-gear servo to use for your flaps.



Whether you use servos with metal gears (left) or with plastic gears, you need to check them for wear. See text for details.

Metal-gear servos fail differently from nylon gear servos. It's pretty easy to see when a nylon gear loses a tooth. The servo stops moving, or stops moving at a certain point, or it may fail completely, so that the control surface drops under its own weight.

Metal gears don't usually break. Instead, something else fails, and the failure is often one of the gear shafts. These shafts extend into the middle and top cases. Rough landings can put enough load on the gears to distort the holes for the shafts, and this might show up as additional play in the gear train. In extreme cases, the shaft will move off center and the servo gears will lock.

Metal gears can wear. Nylon gears wear, too, but not as quickly as metal gears. This wear shows up as additional play in the gear train, and this can prevent the servo from returning to its center. You might then have a jittery control surface, which accelerates the gear wear.

Compare your old servos with new ones. Try to move the control surfaces by hand. With the radio on, if they move or flap around, start looking at the linkages. Look at the servo arm. If it's moving, you need to examine the servo carefully. If it stays put, your linkages need work. That jittery servo might not be from the transmitter swamping the receiver; it might be a result of worn gears.

Repairs require that you change the case, change the gears, or change both. Examine the shaft holes, using a magnifying glass. Are they round, or oval from wear? If they are oval, replace them. Do the gears have a lot of dark "grease" on them? That's probably metal residue that has worn off the gears. You'll need to replace the gears. If you don't have the parts, most manufacturers will repair the servos for a reasonable fee.

OPTIONS IN METAL-GEAR SERVOS

The most common metal-gear wing servo is the Airtronics* 94141, which is notable for the mounting tabs that allow it to be mounted flat in the wing. These servos have been around for several years and are reliable. I find wear occurs most commonly on the shaft holes in the top case, but you have to be pretty hard on the servo for this to happen. Futaba* also offers some good mid-size metal-gear servos, such as the 3002, which makes an excellent flap servo.

Airtronics also makes a very small metal-gear servo. The 94555 is the same micro-size as the 94501 servo and includes aluminum gears. It's a good choice when you need the smallest servo for a wing. The Futaba 5102 servo is slightly larger. I've had some 5102 servos on ailerons for years without any problems. These servos are the same size as the common S133 microservos. JR* recently introduced a metal-gear version of the 341 servo. With its thick nylon gears, the 341 itself is remarkably durable. It will be interesting to see how rugged the 351 will be in actual use, but it does look like a good choice for the new, thinner wing sections being built now.

Drawbacks to metal-gear servos are cost and weight. Expect a few tenths of an ounce weight gain, and add several dollars to the purchase price. Adding an ounce to an unlimited model is OK, but the added cost can be quite significant. On the other hand, pulling out servos to change gears at the field can be a real pain.

AIRFOIL DESIGN

Last month, I talked about classifying airfoils by use. Most model builders talk about airfoils as symmetrical, semisymmetrical or under-cambered. These are all terms that describe what the airfoil shape looks like to the builder, but there are better ways to describe the full spectrum of airfoil choices. If you are talking about the airfoil geometry, the best way to describe an airfoil is through the NACA 4- or 6-digit descriptions. These digits are the combination of the values of the camber line, the location of maximum camber, the maximum thickness (from the 4-digit description) and series number, minimum pressure, range of low drag, design lift and maximum thickness for the 6-digit description (see Figure 1). Symmetrical airfoils have a camber line that is just a straight line; other airfoils (whatever name you give them) have a curved camber line.

When talking about airfoils, we try not to use dimensions, so we usually describe these thickness and camber lines as percentages of the airfoil's chord. These percentages are easily scaled to the desired airfoil size and used to design and construct the wing.

Airfoil designers look at different aspects of an airfoil design. Modern airfoils are designed by specifying the

NACA 4- OR 6-DIGIT DESCRIPTIONS

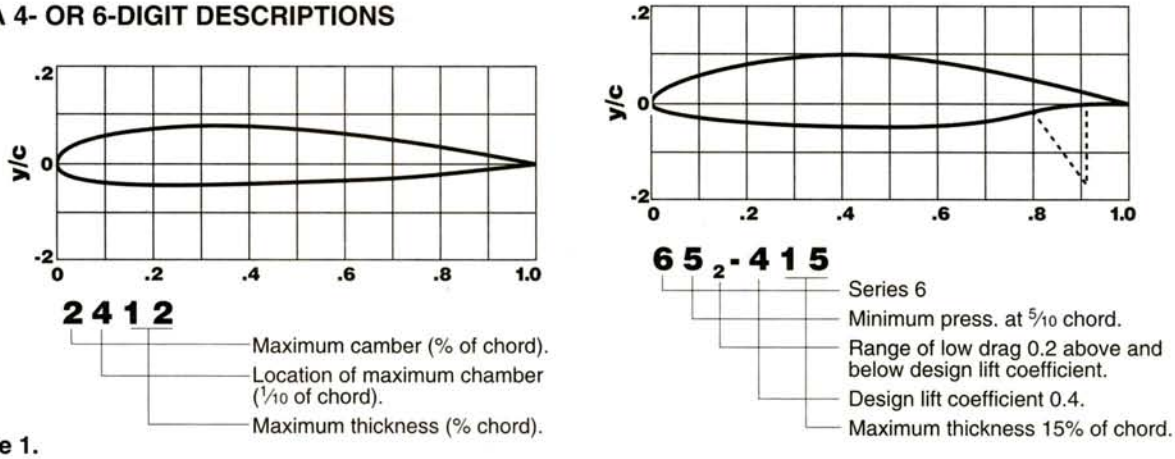


Figure 1.

velocity distributions at different angles of attack for the airfoil. A designer might decide that the velocity should be constant over the first half of the airfoil at a particular angle of attack. Computer codes take this information and compute the airfoil shape required to obtain this distribution. The most advanced codes also let the designer specify bubble ramps for a smooth transition of the flow from laminar to turbulent. The resulting airfoil shape is examined and refined in multiple design iterations and is then tested with performance analysis codes that can take plenty of computer time to get meaningful results. The designer cycles through this process several times to obtain an airfoil that meets the design objectives.

The art of airfoil design really is something only specialists in the area can do with reliable results. For the average modeler, the best you can do is carefully study the lift versus drag graphs from wind-tunnel tests and look at the velocity distributions for the airfoils. The latest UIUC wind-tunnel test results include these velocity distributions.

If you want to look at the velocity distributions around airfoils, there are a few computer programs available. Airfoils for Windows will compute velocity distributions, and it includes information on combining airfoils, blending airfoils and plotting templates. A database of airfoils is available to accompany the program. The version I have has menus in German, but you can figure out what most of them mean. Herk Stokely distributes the program in the U.S. Contact him at SoarTech, 1504 N. Horseshoe Circle, Virginia Beach, VA 23451. Another way to look at the airfoil is by the pressure distribution instead of the velocity distribution. PANDA—a Program for Analysis and Design of Airfoils—from Desktop Aeronautics (P.O. Box A-L, Stanford, CA 49305) is available for Windows and Macintosh. Although PANDA can also compute airfoil polars—lift, moment, and drag versus angle of attack—it is more of an educational tool, and it doesn't replace wind-tunnel tests or more sophisticated analytical tools.

Well that's all for this month. Check out the thermalling tip in the sidebar, and make sure there is no play in those control surfaces.

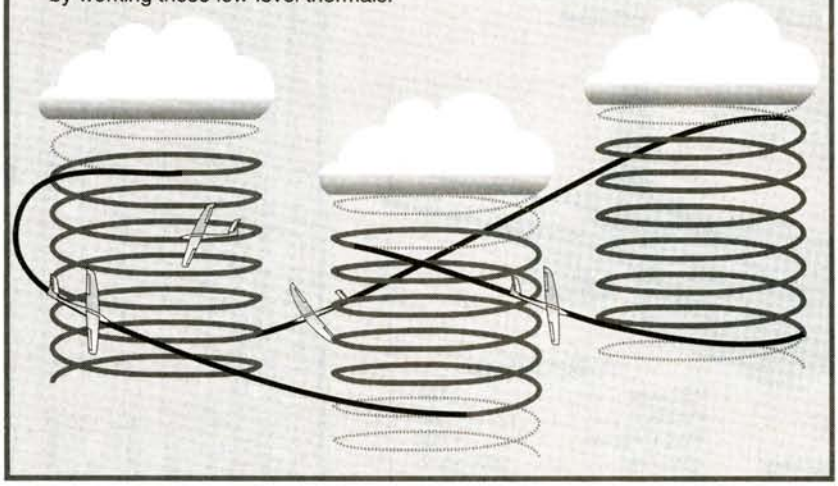
**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

PROBING THERMAL STRUCTURES

It's not possible to see the structure of a thermal in the air. All you can really do is use your sailplane to probe the air, looking for feedback from its flight performance.

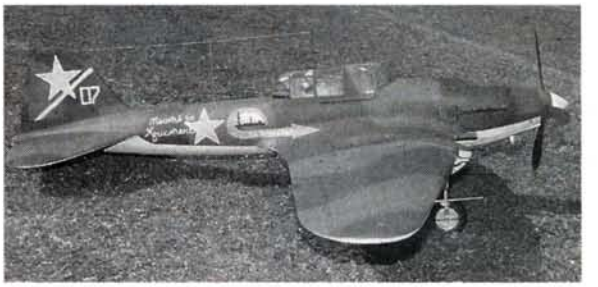
To do this, briefly exit a thermal and lose some altitude. Now re-enter the thermal for a few turns. Exit the thermal again, moving to a slightly lower altitude, and then re-enter it. Keep working the lift this way, and get the glider closer to the ground.

This will do more than just familiarize you with the thermal structure. You will also learn how to bank the model properly for tighter turns when you are closer to the ground and the thermal is narrow. If the thermal is still close to the field and there's space to land safely, you can build your flying confidence by working those low-level thermals.



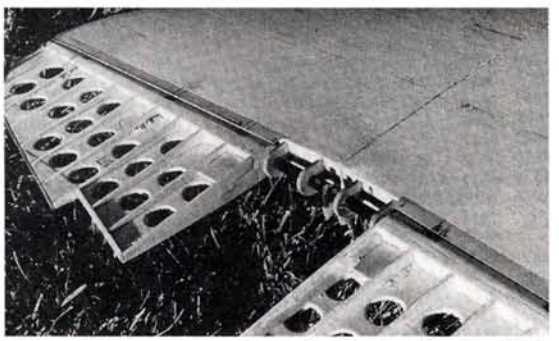
by BOB UNDERWOOD

TORQUE TUBES AND DING-PROOF EDGES



Bob uses his impressive Soviet Stormovik to show off this month's scale techniques.

IN MY 28 years of building scale models, I have been asked many times, "Why?" Well, "why?" indeed! It's not because I have some innate desire to build models that look like "real" airplanes, and it's not because I have some deep-seated love for particular aircraft. I simply enjoy the challenge of producing something tangible with my hands; something that I can point to and say, "That's a product of my skill." That's why I tend to scratch-build seldom-modeled subjects. Because when I've finished, there can be little doubt that they're mine!



The unfinished tail surfaces for Bob's latest project; notice the split torque tubes for elevator control and the built-up elevator surfaces. Also notice the small-diameter aluminum tube that's glued to the trailing edge.

But getting there can be a real challenge. Finding the right subject and locating the documentation is half the battle, but in most cases, planning and developing the techniques you'll need to execute the project is the greatest challenge. I'd be the last person to knock kits, but it's fair to say that you can bypass many hours of work by building a kit. I'm not even addressing things such as molded panel lines, rivets, etc., but rather the basics such as where to put bulkheads, ribs and spars, which materials to use, how to accommodate things such as fuel tanks, retracts, etc. Any way you cut it, scratch-building is a lot more work than building a kit!

I've often said that my building time is 25 percent figuring out how to build it; 50 percent building it; and 25 percent redoing what I did wrong!

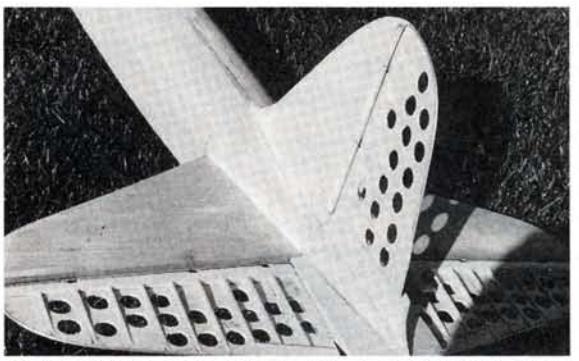
Over the years, I've "borrowed" techniques and layouts from kits and from other people. I've refined some of these ideas on airfoils, equipment placement, linkages, etc., and discarded others. If you build kits, start your own collection of techniques; it will save you time, and you'll produce a better product.

FABRIC-COVERED CONTROL SURFACES

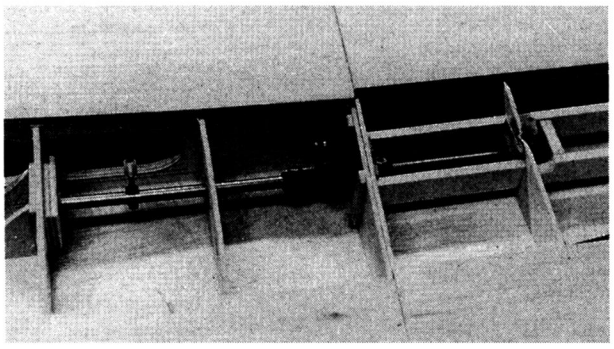
When building tail surfaces and ailerons that will be fabric-covered, I use a simple technique that produces a straight, strong, light structure. I start with a 1/16- or 3/32-inch sheet outline of the stab, rudder, etc., and run the grain from tip to tip. A piece of 1/4- to 1/2-inch stock is glued to the trailing edge of the stab and to the leading edge of the elevator (or fin, rudder, etc.), which is shaped to match the taper toward the tip of the surface. The locations of the ribs are then marked on the sheet, and to form the ribs, 1/16- or 3/32-inch blanks are glued with CA to the top and bottom of the sheet.

Next, the final outline is checked and 1/16 to 3/32 inch is sanded away from the trailing edge. If you look carefully at the picture, you'll see what appears to be a metal edge around the tail surfaces; that's because it is a metal edge! The surfaces are finished with K&S* aluminum tube of the appropriate diameter, usually around 1/16 to 3/32 inch, depending on the scale of the model.

The tube material is roughened with coarse sandpaper and attached using CA. Yes, it takes some time to bend and attach it and yes, it adds some weight! But it makes the trailing edge look better, and it protects the control surface's edge from being "dinged." Also, as you sand the airfoil into the ribs, the block can rest on the aluminum, so you can do a better shaping job. One warning: if you cover it with iron-on material,



Surfaces such as the rudder, elevator and ailerons that will be covered with fabric can be easily made with this technique. The surfaces are made of thin sheet balsa cores with ribs and leading edges glued onto both sides. Aluminum-tube trailing edge increases ding resistance, and lightening holes reduce weight.



The torque-tube flap-drive unit is totally enclosed in the wing. My drive servo is accessible through the outboard end of the inner wing panel. This torque-tube drive system is made with metal tubes and includes Byron's plug-in system for removal of the wing panels.

you may have to turn up the heat on the iron a notch, because the aluminum absorbs heat.

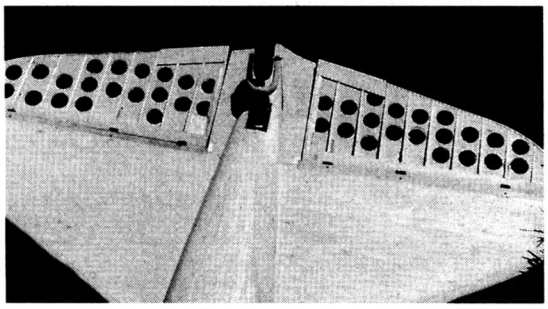
You may have also noted that the base wood material has been "swiss cheesed." People have suggested that this is a lot of extra work for a small weight reduction. That's true! But remember that "an ounce in the tail is worth four (or more) ounces in the nose." We all know that a list of nose-heavy scale models could be inscribed on the head of a pin!

TORQUE-TUBE LINKAGE

Linkages present an interesting challenge. Scale modelers cringe at the sight of servos hanging unceremoniously from the underside of wings or draped on the outside of fuselages at the tail of large aerobatic models! But getting to the control surface without external linkages and without a lot of "slop" in the system and being able to mount the servo in an accessible location is the challenge. I use a lot of torque rods.

The photo shows flap linkages for a model I recently built. The flaps are split between an outer panel (right) and an inner panel (left). A Byron Originals* plug-in system allows the panels to be separated and provides a drive system for the servo. The torque tube shown here is a metal rod that fits inside the Byron fitting and is anchored with a machine screw through the rod and fitting.

The drive fitting for the pushrods to the flap is placed at each end of the rod. Again, the fittings are machine screws (usually 4-40 or 6-32) inserted through a drilled and tapped hole in the rod, and topped by an appropriate attachment fitting to accommodate the pushrod clevis.



The elevators are slightly angled, so it's impossible to use a common straight torque-tube drive; I used the split-torque-tube setup, which allows the elevators to be removed (or assembled) after finishing.

The servo is not yet shown, but it will be mounted on its side where the arm of the Byron fitting is located. When all the sheeting is in place, it can be accessed through the outboard end of the wing center section. The aileron servo is mounted on the inboard end of the outer panel and drives a torque tube out to the aileron.

Metal tubes aren't necessary. Arrow shafts or other carbon-fiber-type rods may be used). Typically, I glue a piece of wooden dowel inside the tube with CA at the point where the machine screws pass through; an inch or so is fine. This provides a little more "meat" for the screw to grab. Just plan where the machine screw is going so you don't miss the dowel-reinforced portion; been there, done that!

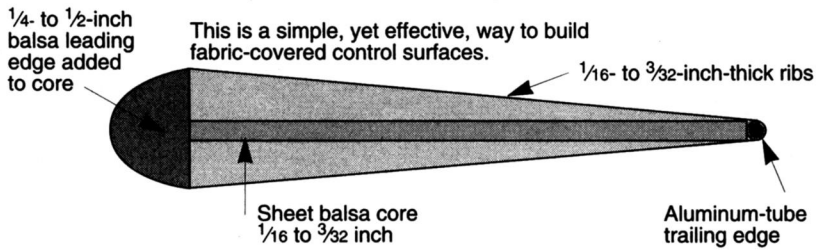
If you want to make it fancy, use nylon bearings to support the torque tube. Sig* has some ¼-20 nuts that can be drilled out for this purpose. Plywood bearings will also work. Once they've been sized properly, I coat the inside surface of the ply bearing with thin CA and burnish it with the shank end of an appropriately sized drill bit.

SPLIT-ELEVATOR TORQUE TUBES

The elevator drive system shown uses the methods mentioned above. The outer machine screw is inserted into aluminum tube sandwiched between plywood in the elevator halves. This way, the elevators can be removed (or assembled) after finishing. Careful examination reveals that in the case of this model, the torque-tube drive is divided between elevator halves, because the elevators are angled slightly; it's impossible to use a common torque-tube drive. Why? Don't ask! I have no idea why the Russian designer of the "Stormovik" didn't like a straight hinge line! I just duplicated it, that's all!

Golly, that's enough for this time around. Besides, it's time to get back to building!

Cross-section of built-up elevator



** Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

Golden AGE OF R/C

by HAL deBOLT

OT NEWS FROM NEAR AND FAR

Peter Cary's 30-year-old LW Champion on a close flyby.

HOPE YOU'VE enjoyed my recent columns on R/C history. Now it's time to devote a column to your fine input. Do remember this is *your* OT R/C place, and what you offer is appreciated and needed.

Let's start with Ed Izzo, who was recently elected to the AMA Hall of Fame. According to a nice letter from Walt Throne of the Central New York Model Aircraft Association, Ed was to be inducted posthumously during the CNYMAA Model Expo in January. Walt indicates that the honor was to be accepted by Ed's wife, Louise, who contributed so much to Ed's accomplishments.

Hall of Famer Ed Izzo, with one of his last fine models.

Col. Robert Mosher of San Antonio, TX, is a true OT'er who apparently enjoys travel. On a recent safari, Bob had the opportunity to visit Al Diem in Salt Lake City. Oldsters will recall Al as an electronic guru with the DC/RC club, who was active early on with the Selinsgrove meetings. Al is still active, and as you can see in the photo, he has yet to straighten up his workshop! (Just kidding! We know that cleaning takes precious time away from building.)

Bob Cooper of Savannah, GA, had read my "Thunderbolt" article and noted my experience that resulted in the use of a full flying fin to get more fin action. Bob was concerned that he might see a similar problem with a Goldberg sailplane that he had in process. I had noted that my replica obviously had excessive power. With a normal rudder, there was no problem until max power was used—far more than the original T-bolt with its Ohlsson .23. Excessive power was the culprit! Bob's info is that his docile-powered sailplane works just fine with a normal rudder. The lesson? Could be that what suits the goose doesn't always suit the gander! Otherwise, I should say that a full flying fin offers ultimate yaw control on most models and even works great on gliders.

Peter Cary of Edmonton, Alberta, Canada, tells us he is the fourth owner of this 30-year-old Champ, which required much tender loving care to put it into its present pristine condition (see his fine action photo). This Champ is now powered with an HP 21fc, which provides 45 minutes' flying time with 6 ounces of fuel. He uses a vintage Futaba R/C for the nostalgia effect.

A local R/C instructor, Peter is well-versed in the virtues that were objectives with the original Champ, especially that the Champ will fly itself à la free flight. So, a student who zigs instead of zags only has to release the TX stick for the Champ to right itself. Peter believes the Champ provides novice pilots with an excellent education and is slow enough to give them plenty of time to think about what they're doing. Pete thinks it is too bad something similar is not available today.

Col. Bob Mosher visits transplanted OT R/C'er Al Diem in his Salt Lake City workshop.

REMEMBERING A PIONEER

Recently, an OT'er provided some input that related to Frank Schwartz of Nashville, TN, and our mention of Frank brought a nice long letter from him. I would be remiss if I did not share some of his memories with you, as they probably parallel early R/C activity in the mid-south area.

Previously, we told how this pioneer was a guiding light for early R/C activities, thus ensuring that newcomers to the sport were ready to try flight. He spent countless hours sorting out fellow club members' radio troubles.

Frank's experiences were similar to the ones many of us had. He entered modeling in the early '30s, saving his pennies for a 10¢ ROG kit or even a 29¢ Burd Korda, later moving on to finer models.

With the advent of R/C, like so many others, he attempted to produce his own systems. Frank tells of tearing up numerous

A TRIBUTE TO LOU ANDREWS

One asset of competitive modeling is the opportunity to travel and meet people from beyond your locality. Some become lifelong cherished friends, as it was with Lou Andrews and me.

Lou Andrews returns from the flight line at an early days Nats pylon—racing event.

Lou calls for Hal deBolt at an early '60s Nats pattern flight.

The Louis J. Andrews whom I knew was an industry competitor, a modeling buddy, a visionary model aircraft designer, an immaculate builder, an excellent pilot (both control line and radio-controlled) and a man who thought of others. Over the many years our camaraderie continued, and it was always a great reunion whenever we met. The sorrow for me is that, during later years, Lou was incapacitated, and he was sorely missed by many of us.

In one of his last letters, Lou bemoaned the fact that the malady that affected his eyesight kept him away from designing and flying. You can imagine how he missed his modeling in those final years.

We know that Lou entered the model industry with Guillow in CL days. Remember his Barnstormer and Trixter, which flew inverted as easily as upright—probably the first kit to do so. With Guillow, he offered the second true R/C kit. Surely any OT'er will recall the fine little Trixter Beam!

Lou left Guillow to form his own Andrews Aircraft Model Co., specializing in R/C. With his "H" and "Master" series, modeling was again blessed with high-quality products, until a vandal-set fire destroyed his operation. Lou was a proud man and thought that his Aeromaster biplane best exemplified the tradition of the two-wingers—rightly so, as attested to by the long life of the kit. Modeling recognized this great man with an AMA fellowship and induction into the Hall of Fame.

Our lives do go on, but with sadness; so sorry to lose Lou.

headphones to get coils for reed banks—Radio Shack was far into the future! Says he had some success with a Bell system in a 6-foot-long cabin model, but it ate batteries like you could not believe!

As his knowledge grew, he did some development work for Citizenship, and that included "relayless" reeds and servo amplifiers. In the era of 27MHz, being able to use the 6-meter ham band was a cherished advantage. Frank converted many local fliers' systems to that 50MHz band. His friend Dick Patton's converted Bramco system is still operational these 40 years later.

Frank recalls my '60s visit; I was flying the prototype Acrobat biplane and, apparently impressed, they prevailed upon me for plans, from which several were built and enjoyed. He vividly remembers how well my Space Control operated, compared with the models he was producing. He bemoans the fact that even my constant contact with Citizenship didn't help them to come up with anything as good. I remember enjoying our collaboration. Frank says he stopped "home building" when a Bonner digital system proved successful, and he has never seen a need to go back.

At age 70, Frank Schwartz is retired, and now that he has the time to build and fly steadily, he enjoys everything from ½A to giant scale. Frank feels these are just great R/C times, but he does regret that he has had to give up his favorite activity—pylon racing—because of diminished eyesight. Frank Schwartz is so typical of the many early birds throughout the land who did so much to bring R/C modeling to where it is today. They are appreciated!

And so it was, great doings and memories now for those who were there!

A health plan for your battery pack

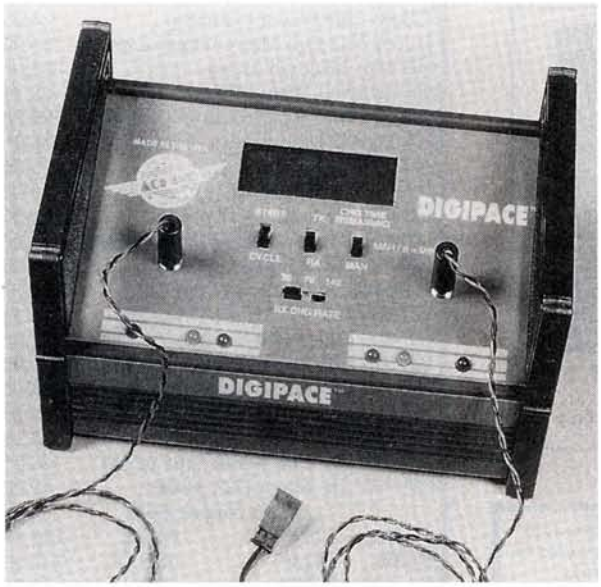
MODEL AIRPLANE NEWS
PRODUCT REVIEW

Ace R/C
DigiPace 3

by ROGER POST SR.

WITH THE winter coming to a close and the flying season just around the corner, I thought it would be a good idea to cycle my radio batteries and get my planes ready to fly. During the non-flying season (for those of us who have one), cycling is the most important procedure in the maintenance of dormant batteries.

Thanks to the Ace R/C* DigiPace 3 battery-management system, I found a bad transmitter pack and two bad receiver packs. The transmitter pack had one dead cell, which did not show up on the transmitter meter readout, and the receiver packs were old and would not come to the 70 percent operational mAh capacity recommended by the instructions (good things to find out *before* you start flying!).



The Ace R/C DigiPace 3 comes with 4 feet of wire and two, 0.10-inch-pin power plugs with which to make charging cables.

ACE'S DIGIPACE

At the top, the DigiPace 3 has a highly visible four-digit LED display that shows the time remaining to fully charge the batteries or the operational capacity of your battery pack in mAh. Below the display are three switches; the left one is to start the cycle, the middle one is to check the data on the transmitter and receiver packs, and the right one will tell you the charging time left (when it's in the up position) and the operational capacity in mAh (when in the down position). Under these switches is a three-position switch that determines the receiver charging rate; its settings are 35, 70 or 140mA; the transmitter is automatically charged at 70mA.

On the bottom of the unit, there are six LEDs—three on the left for the transmitter and three on the right for the receiver. The red LED is for discharging, the green one ("Norm") is for charging, and the yellow one is for trickle-charging.

The DigiPace 3 will discharge both the transmitter packs and the receiver packs at the same time (red LEDs lit on both sides), and it will automatically switch to charging (green LEDs lit) when the discharge cycle has been completed. After the charging cycle has been completed (16 hours), the DigiPace 3 will automatically go to the trickle-charge mode (yellow LEDs lit).

As well as the unit and separate power-supply cord, you get an extremely informative Ni-Cd battery data sheet (which tells you about the care, charging and cycling of Ni-Cds), an operation manual, battery data log sheets (on which to record cycling information), 4 feet each of red and black wire, two 0.10-inch-pin power plugs and a limited lifetime warranty.

THE MANUAL

Before you do anything with the DigiPace 3, read the operation manual thoroughly; it's very detailed and contains an amazing amount of information. To make charging wires, I cut the supplied wires in half and soldered the power plugs onto one end of each wire set, making sure that red was on the plug's "+" pin and black was on the plug's "-" pin. On the opposite end of one of the wires, I installed an Airtronics* receiver adapter plug, and on the end of the other wire, I installed an Airtronics transmitter adapter plug. Make sure you check your polarities as you do this procedure. If you have a JR* radio, the transmitter cable must have the positive and negative hook-up reversed on the 0.10-inch power plug.

OPERATING THE UNIT

Plug the power-supply adapter into the right side of the DigiPace 3, and turn it on. The display will automatically count down, doing a 5-second self-diagnostic sequence, and then display the word "ACE." This means that there aren't any batteries hooked up yet.

Important: there are three things you *must* do when hooking up your batteries to the DigiPace 3.

• Connect directly to the transmitter and receiver batteries (some brands of transmitter have a diode in the circuit to pre-

SPECIFICATIONS

Input voltage	110 volts AC (standard version) 220V volts ("A" version)
Discharge current	360mAh Rx and Tx
Cutoff voltage	1.05 to 1.1V/cell. (4-cell Rx; 8-cell Tx)
Normal charge rates	Tx = 70mA Rx = 35, 70 or 140mA
Trickle-charge rate	10mA
Normal charge time	16 hours (timed)
LED read-out	mAh (1-9999) and normal charge time remaining (16 hours, 00 minutes to 00 hours, 00 minutes)
Warranty	Limited lifetime
Price	$149.95.

Comments: this compact unit from Ace R/C offers a reliable way to cycle, charge and determine the mAh capacity of your batteries. The manual and Ni-Cd battery data sheet is packed with information that will increase your knowledge of batteries and why we cycle them.

ent you from reverse charging). To cycle e transmitter battery, this diode has to be passed.

You have to make sure you have the correct polarity.

Make sure that your battery-pack leads do not short out. In its manual, Ace cautions: "If the DigiPace 3 is improperly hooked up either the receiver or transmitter, causing reverse polarity, the DigiPace 3 and the batteries will be damaged." If you're unsure of the polarity, use an Ace voltmeter to verify the polarity.

Here are some of the cables that are available from Ace R/C.

Now back to the display. Hook up your batteries; you'll notice that the green lights come on. If you move the mAh switch to the "mAh" position, the display reads "0000." Choose the proper mA rate for your receiver pack with the three-position rate switch; then move the mAh switch to the "charge-time remaining" position; you'll see that it reads 16.00," which indicates the total time of charge.

To start cycling, slide the start cycle switch upward and then release it. The green LED goes out, and the red LED comes on to show that the unit is in the discharge mode. When the batteries have been discharged to 1 volts per cell, the unit will switch to the charging mode. Then, after 16 hours, it will change to the trickle mode.

You can discharge one pack and charge another at the same time by starting the discharge on one pack and then plugging in the other pack to be charged. The discharge current on both the transmitter pack and the receiver pack is 360mA. This is more than the normal energy consumption of a transmitter, and it is in excess of the average current drain of a 4- to 6-channel, properly functioning airborne system.

You'll appreciate the DigiPace 3's design in your workshop, because you can pack it with other Ace equipment to save space, or you can hang it in a convenient spot on the wall.

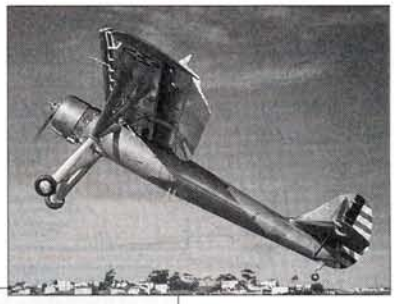
So, pull out those packs and check to see whether they are what they claim to be. The DigiPace 3 is a great tool for doing this; you'll find it easy to use, and it's an extremely handy addition to your workshop. It will also save you some rebuilding time necessitated by battery failure. Good luck!

**Addresses are listed alphabetically in the Index of Manufacturers on page 139.*

Name THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If you can, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897-3035.



CONGRATULATIONS to E.A. Powers of Archer, FL, for correctly identifying the February '96 mystery plane. The Ryan YO-51 "Dragonfly" was a tandem, two-seater, Army Co-operation monoplane that could land at and take off from very short airstrips. It was the first American plane developed to be used with ground troops; with its wide speed range, its duties included spotting for artillery units, short-range re-connaissance and liaison work. The wing was made out of a two-spar wooden structure that was covered mostly with plywood. The Fowler flaps and leading-edge slots ran the entire length of the 52-foot wingspan and had aluminum-alloy frames covered with fabric. Powered by a 420hp Pratt & Whitney Wasp-Junior 9-cylinder, radial, air-cooled engine, the 35-foot, 5½-inch-long Dragonfly was 11 feet, 1 inch high and had a loaded weight of 3,900 pounds. Thanks to all who wrote in; good luck next month!

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to *Model Airplane News*. If already a subscriber, the winner will receive a free one-year extension of his subscription.

INDEX OF MANUFACTURERS

Ace R/C, 116 E 19th St., Higginsville, MO 64037-0472; fax (816) 584-7766.

Aero Dynamics, 4090 Deer Valley Rd., Rescue, CA 95672.

Aerospace Composite Products, 14210 Doolittle Dr., San Leandro, CA 94577; (510) 352-2022; fax (510) 352-2021.

Airtronics Inc., 11 Autry, Irvine, CA 92718; (714) 830-8769.

Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.

APC Props; distributed by Landing Products, P.O. Box 938, Knights Landing, CA 95645; (916) 661-6515.

Astro Flight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242; fax (310) 822-6637.

Balsa USA, P.O. Box 164, Marinette, WI 54143; (800) 225-7287; fax (906) 863-5878.

Bob Dively Models, 38131 Airport Pkwy. #206, Willoughby, OH 44094; (216) 953-9254; fax (216) 953-9311.

Bob Violett Models (BVM), 170 State Rd. 419, Winter Springs, FL 32708; (407) 327-6333.

Byron Originals, P.O. Box 279, Ida Grove, IA 51445; (712) 364-3165; fax (712) 364-3901.

Century Jet Models, 11216 Bluegrass Pky., Louisville, KY 40299; (502) 266-9234; ax (502) 266-9244.

Cool Power; distributed by Omega Games, 8802 Rocky Creek Dr., Ste. 2-149, Tampa, FL 33615; (813) 661-3804; (813) 681-7446.

Coverite, 420 Babylon Rd., Horsham, PA 19044; (215) 672-6720; fax (215) 672-9801.

Czech Mate Distributing Inc., 7 Switchbud Place, Ste. 192-211, The Woodlands, TX 77380; (713) 364-8011

Dave Brown Products, 4560 Layhigh Rd., Hamilton, OH 45013; (513) 738-1576; fax (513) 738-0152.

Davis Model Products, P.O. Box 141, Milford, CT 06460; (203) 877-1670.

Du-Bro Products, P.O. Box 815, Wauconda, IL 60084; (708) 526-2136; fax (708) 526-1604.

Dynamax; distributed by Jet Model Products, 211 N. Mullen Rd., Belton, MO 64012; (816) 331-0356.

Dynathrust Props, Box 91, Georgetown, TN 37336; (615) 476-2330.

Enya; distributed by Altech Marketing (see address above).

F&M Enterprises, 22522 Auburn Dr., El Toro, CA 92630; (714) 583-1455; fax (714) 583-1455.

Futaba Corp. of America, P.O. Box 19767, Irvine, CA 92713-9767; (714) 455-9888.

Glennis Aircraft, 5528 Arboga Rd., Linda, CA 95901.

Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728; (714) 964-0827; fax (714) 962-6452.

Graupner; distributed by Hobby Lobby Intl. (see address below).

Great Plains Model Distributors, P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300; (217) 398-1104.

Hangar Nine; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

Hatori; distributed by Great Planes Model Distributors (see address above).

Hayes Products; distributed by Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651; (312) 626-9550.

Hitec/RCD Inc., 10729 Wheatlands Ave., Ste. C, Santee, CA 92071-2854; (619) 258-4940; fax (619) 449-1002.

Hobby Lobby Intl., 5614 Franklin Pike Cir., Brentwood, TN 37027; (615) 373-1444; fax (615) 377-6948.

HobbyPoxy, 36 Pine St., Rockaway, NJ 07866; (201) 625-3100; fax (201) 625-8303.

IMP (Innovative Model Products), P.O. Box 333, Remsen, NY 13438.

ISC International, 10620 N. College Ave., Indianapolis, IN 46240; (317) 846-0766; f ax (317) 848-1015.

Jet Hangar Hobbies, 10595 Bloomfield Ave., Los Alamitos, CA 90720; (310) 493-1285; fax (310) 493-1765.

JR Remote Control; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

K&S Engineering, 6917 W. 59th St., Chicago, IL 60638; (312) 586-8503.

Kress Jets, 4308 Ulster Landing, Saugerties, NY 12477; (914) 336-8149; fax (914) 336-5975.

Lofty Pursuits, 2274 Aster Ct., Rapid City, SC 57702-5103; (605) 343-8760.

Magnum; distributed by Global Hobbies (see address above).

Major Decals/Northeast Screen Graphics, 21 Fisher Ave., East Longmeadow, MA 01028.

Master Airscrew; distributed by Windsor Propellor Co., 3219 Monier Cir., Rancho Cordova, CA 95742; (916) 631-8385; fax (916) 631-8386.

Midwest Products, P.O. Box 564, Hobart, IN 46342-0564; (800) 348-3497.

Model Tech; distributed by Global Hobbies (see address above).

Modelair-Tech, P.O. Box 12033, Hauppauge, NY 11788-0818; (516) 979-1475.

Nelson Competition Engines, 121 Pebble Creek Ln., Zelienople, PA 16063; (412) 538-5282.

Nick Ziroli Models, 29 Edgar Dr., Smithtown, NY 11787.

Nick Ziroli, 605 E. Monroe St., Little Falls, NY 13365; (315) 823-1208.

O.S.; distributed by Great Planes Model Distributors (see address above).

Paul's Flying Stuff, P.O. Box 121, 1281 Rincon Rd., Escondido, CA 92025; (619) 743-5458.

Performance Specialties, P.O. Box 3146, Gardnerville, NV 89410; (702) 265-7523; fax (702) 265-7522.

Pica/Robbe Inc., 2655 N.E. 188 St., Miami, FL 33180; (305) 932-1575; fax (305) 937-2322.

Quadra-Aerrow Inc., P.O. Box 183, 1881 Rogers Rd., Perth, Ontario, Canada K7H 3E3.

Robart Mfg., P.O. Box 1247, 625 N. 12th St., St. Charles, IL 60174; (708) 584-7616; fax (708) 584-3712.

Rocket City R/C Specialties, 103 Wholesale Ave. NE, Huntsville, AL 35811; (205) 539-8358.

Royal Products Corp., 790 W. Tennessee Ave., Denver, CO 80223; (303) 778-7711; fax (303) 778-7721.

Seidel; distributed by Proctor Enterprises, 25450 N.E. Eilers Rd., Aurora, OR 97002; (503) 678-1300; fax (503) 678-1342.

Sermos R/C Snap Connectors Inc., Cedar Corners Station, Box 16787, Stamford, CT 06905.

Sig Manufacturing Co. Inc., 401 S. Front St., Montezuma, IA 50171; (800) 247-5008 (order only); fax (515) 623-3922.

Sonic Tronics, 7865 Mill Rd., Elkins Park, PA, 19027; (215) 635-6520; fax (215) 635-4951.

Stika; distributed by Sky Aviation, 1320 Gay Lussac #106, Boucherville, Quebec, Canada JG4 7G4.

The Aeroplane Works, 2134 Gilbride Rd., Martinsville, NJ 08836.

Thunder Tiger, 2430 Lacy Lane #120, Carrollton, TX 75006; (214) 243-8238.

Top Flite; distributed by Great Planes Model Distributors (see address above).

TRC Engineering, 10707 Whispering Valley La., Middleville, MI 49333; (616) 795-9585.

Tru-Turn, P.O. Box 836, South Houston, TX 77587; (713) 943-1867.

ZAP Glue, 9420 Santa Anita Ave., Rancho Cucamonga, CA 91730.

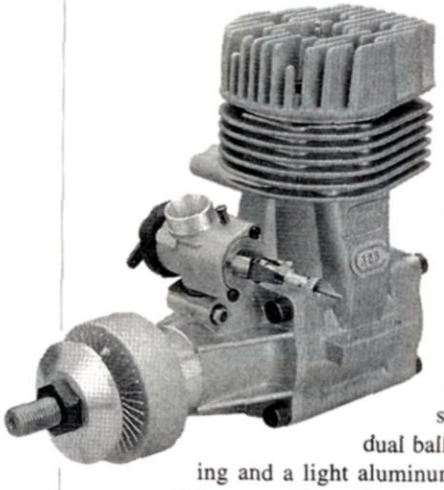
Zenoah; distributed by Indy R/C, 10620 N. College Ave., Indianapolis, IN 46280; (800) 338-4639.

Zinger; distributed by J&Z Products, 25029 Vermont Ave., Harbor City, CA 90710.

Ziroli; (see Nick Ziroli).

ADVERTISER INDEX

LATEST PRODUCT RELEASES



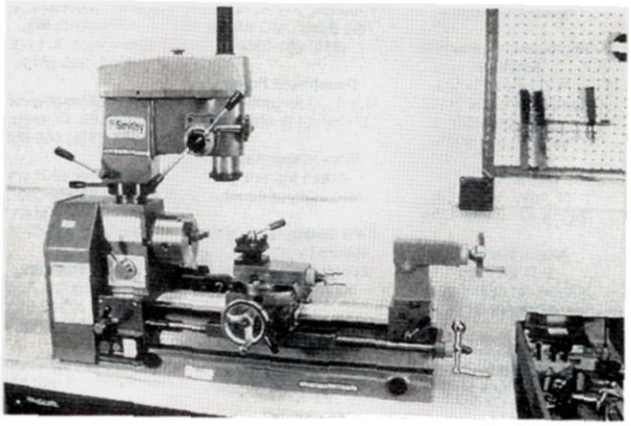
SUPERTIGRE

Giant-Scale Engine

The new G-3250 engine produces 10 percent more power—3.3b.hp at 7,900rpm—than the S-3000K, with no increase in size or weight. It has improved idling capabilities and smooth transitions from low to high rpm. It features a precision-balanced crankshaft, dual ball bearings, Schnuerle porting and a light aluminum piston. It comes with a radial mount. (A muffler is available separately.)

Part no.—SUPG0268; **price**—$399.99.

SuperTigre; distributed by Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826-9021; (217) 398-6300; fax (217) 398-0008.



SMITHY COMPANY

CB-1220 Lathe-Mill-Drill

This combination lathe-mill-drill machine can be used to cut steel, aluminum, plastic and wood; make round or cylindrical pieces; enlarge holes; cut smooth, flat surfaces, slots and angles; and drill, ream and bore. It features an adjustable lead screw and cross-feed nuts, full floating dials and an offset tailstock.

Price—$1,635.

Smithy Co., 170 Aprill Dr., P.O. Box 1517, Ann Arbor, MI 48106-1517; (800) 476-4849 or (313) 913-6700; fax (313) 913-6663.

LDM INDUSTRIES INC.

Combat Fighter Series Video

LDM's latest promotional video provides information on the construction and flying of LDM combat kits. Each video includes $10 worth of discount coupons good toward the purchase of combat kits.

Price—$7.95.

LDM Industries Inc., P.O. Box 292396, Tampa, FL 33687-2396; (813) 991-4277; fax (813) 991-4810.

KRESS JETS INC.

A-6E Grumman Electric Intruder

This kit features sheeted foam-core wings and a 1/32-inch-thick, balsa-sheeted foam fuselage with vacuum-formed shells to provide the aerodynamic shape. The model can easily be converted to glow power. Specifications: wingspan—52 inches; weight—67 ounces; wing area—438 square inches; wing loading—22.2 ounces per square foot.

Price—$155.95.

Kress Jets Inc., 4308 Ulster Landing Rd., Saugerties, NY 12477; (914) 336-8149; fax (914) 336-5975.

TNC ELECTRONICS

PT+10 Tachometer

Designed especially for AT-6 racers, this update to TNC's Sensi-Tach optical tachometer line has a readout in increments of 10rpm and a reduced range of approximately 1,000 to 30,000rpm. It has the same accuracy, sensitivity and steady digital readout as TNC's other tachometers.

TNC Electronics, 2 White's Ln., Woodstock, NY 12498; (914) 679-8549; fax (914) 679-5542.

JR REMOTE CONTROL

F-400 FM Radio System

This new 4-channel radio is great for the first-time flier who's on a budget. Besides the transmitter, which features servo-reversing and a comfortable-to-hold "biocurve" case, the system comes with three 507 servos, wall plug-in charger, switch harness, 12-inch aileron extension, servo-mounting hardware, Sanyo 600mAh batteries in the TX and RX, and the "credit card" R-600 6-channel FM receiver.

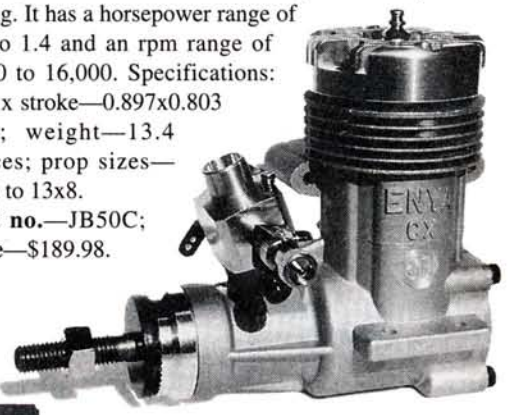
JR Remote Control; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

ALTECH MARKETING

Enya 50CX with Muffler

This ABC 0.51ci engine is equipped with a 7.5mm-intake, two-needle carburetor for power and precise tuning. It has a horsepower range of 0.9 to 1.4 and an rpm range of 2,500 to 16,000. Specifications: bore x stroke—0.897x0.803 inch; weight—13.4 ounces; prop sizes—11x6 to 13x8.

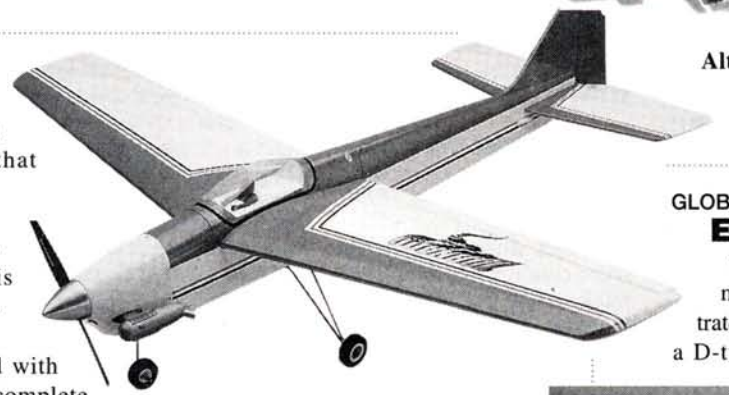
Part no.—JB50C; **price**—$189.98.



Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.

GLOBAL

Tornado A.T.



The Advanced Trainer is a mid-wing-pattern plane that comes pre-built and covered and is 95 percent ready to fly. The wings are pre-joined, the aileron mount is pre-installed and all control-surface hinges are glued in place. The plane is covered with Goldberg Ultracote, has a complete hardware package and requires a 4-channel radio. Specifications: wingspan—56 inches; length—53 inches; wing area—602 square inches; weight—5.72 pounds; engine required—.40 to .53 2-stroke.

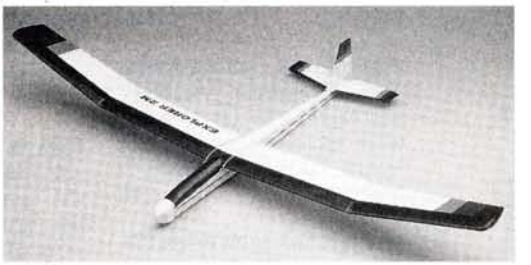
Part no.—126520; **price**—$230.

Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.

GLOBAL HOBBY DISTRIBUTORS

Explorer 2M ARF

This factory-built and -covered model comes with a photo-illustrated instruction manual. It features a D-tube structure and an I-beamed wing with a Clark-Y airfoil; its long tail moment helps to control errors and smooth the effects of wind turbulence. Specifications: length—45.1 inches; wingspan—78.8 inches; wing area—596 square inches; weight—40 ounces; radio required—2-channel.



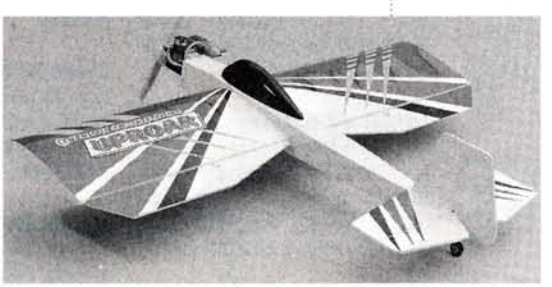
Part no.—127030; **price**—$129.95.

Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.

TOWER HOBBIES

Uproar

This inexpensive aerobat allows fliers to do unlimited vertical climbs, loops and rolls for days, tearing up the sky. Uproar's oversized control surfaces deliver flick-of-the-stick response, and its thick airfoil allows steep dives without building up speed. This model's all-wooden airframe is light and stress-resistant. The kit includes full-size plans, photo-illustrated instructions and tail-dragger landing gear. Specifications: wingspan—48 inches; wing area—578 square inches; weight—3.5 to 4 pounds; length—42 inches; requires a 4-channel radio with five standard servos; engine size—.32 to 40 2-stroke.



Part no.—TOWA2020; **price**—$49.99 (kit), $99.99 with engine.

Tower Hobbies, P.O. Box 9078, Champaign, IL 61826-9078; (217) 398-3630; fax (217) 356-6608.

CLASSIFIEDS

BUSINESS

MAKE REAL DECALS with your computer and printer. Send $10 for introductory kit to: LABCO, Dept. MAN, 27563 Dover, Warren, MI 48093.http://www.mich.com/~labco/ [8/96]

ENGINES FOR LESS: New and used save big money! O.S., SuperTigre, Fox, Enya, K&B, McCoy, Saito & more! All used engines come with lifetime trade-back guarantee! Consignment sales. Trade-in's too! Send legal-size S.A.S.E. or postage to get free list to: HWC, P.O. Box 94, Boystown, NE 68010. [5/96]

EXPERIENCE, INGENUITY, SOLID CRAFTSMANSHIP. We build from kits, plans, scratch, or your imagination. Service fully guaranteed. Hangar Heins R/C Aircraft; (513) 528-7221. [5/96]

SOPHOS AVIATION T-SHIRTS. Over 90 designs; send $2 for catalogue. 5331 San Fernando Road West, Los Angeles, CA 90039. [7/96]

ANTIQUE IGNITION - GLOW PARTS CATALOGUE, ½-inch THICK. Timers, needle valves, cylinder heads, pistons, tanks, spark plugs, race car parts. Engines ½A, Baby Cyclone, McCoys, Phantoms, etc. $10 postpaid (U.S.), $20 foreign. Chris Rossbach, 135 Richwood Dr., Box 390, Gloversville, New York 12078. [8/96]

PLASTIC RC ACCESSORIES- "Skidgards," "Sqwiggles," "Plug-alongs" and "Timerkeepers." Catalogue $1 & return address. Tetherite Plastic Products, P.O. Box 57764, Webster, TX 77598. [8/96]

NEW ZEALAND AERO PRODUCTS. Scale plans: Rearwin Sportster, Hall's Springfield Bulldog, Typhoon, Pawnee, Airtruk/Skyfarmer, Agwagon, Pawnee Brave, Fletcher FU-24, DC-3/C-47, Fairchild PT-19, Fleet PT-26, Cessna Aerobat, and more. Hardware Paks, color photo paks available. Free documentation with plans. Catalogue/Price list: $5 (U.S.); Visa/MC. 34 Ward Parade, Stirling Point, Bluff, New Zealand. Phone/24-hr. fax 0064-03-212-8192. [2/97]

SKYSHINE—Holographic high visibility trim film 3x18-inch strip—$5. Sample SASE. Phil Pearce, 111 E. Geneva Dr., Tempe, AZ 85282. [5/96]

MODEL WARPLANES, 1996: over 10,000 plans, kits, photos, 3-views listed. Send SASE to John Fredriksen, 461 Loring, Salem, MA 01970 (508) 745-9849. [7/96]

PLYWOOD—Aircraft quality Finland Birch. Call for free price list: (800) 222-7853. [2/97]

WW I PLANS AND MORE. Laser cut ribs and formers. Send $5 to Clarke Smiley, 23 Riverbend, Newmarket, NJ 03857. [10/96]

SCALE AIRCRAFT DOCUMENTATION and Resource Guide. Larger, updated 1996 edition. World's largest commercial collection. Over 5,800 different color FOTO-PAAKS and 33,000 three-view line drawings. 188-page resource guide/catalogue—$8; Canada-$10; foreign-$15. Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [8/96]

R/C WARBIRDS ON VIDEO. Warbirds 95, Birds of Prey 95, Jumbo Jamboree 95, $19.95 each plus $3 S&H. A.M.R. Productions, P.O. Box 1813, Toms River, NJ 08754. [10/96]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [12/96]

SODA-CAN AIRPLANES—replica biplane detail plans with photos $7.50 PPD, Early's Craft, 15069 Valley Blvd. SP 26, Fontana, CA 92335. [8/96]

REPLICA SWISS WATCHES—18KT goldplated! Lowest prices! Two-year warranty! Waterproof! Divers, Chronographs, others! Phone (770) 682-0609; Fax (770) 682-1710.

AERO FX BY JO DESIGNS—exact-scale, computer-cut, high-performance vinyl graphics and paint masks. Lettering; nose art; insignia for scale; pattern, pylon and sport fliers; complete graphic sets available. Call or write for free sample and catalogue. JO Designs, Rt. 1, Box 225 AA, Stratford, OK 74872; (405) 759-3333; fax (405) 759-3340. [5/96]

BOB FIORENZE BUILDING SERVICE. Jets, warbirds and helicopters. Contact Bob at (407) 330-1448. Our experience is your best assurance. [6/96]

ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$6 (intl. airmail—$8). Aero-Electric, 3706 North 33rd, Galesburg, MI 49053. [10/96]

PLANS ACCURATELY ENLARGED or copied. Any scale, any size. Money-back guarantee. Send $2 for info and a customized poster for your shop. Roland Friestad, 2211M 155th St., Cameron, IL 61423. [6/96]

PLANS ENLARGING. Old model magazines, scanning, plotting, model software. Free information. Concept, P.O. Box 669A, Poway, CA 92074-0669; (619) 486-2464. [5/96]

VACUUM-FORMING—Your one-stop source for books, plastic sheets, components and ready-to-use machines in three sizes. New for '95, Hobby Vac System 2 machines. Free catalogue—(800) 391-2974; Vacuum Form, 272B Morganhill Dr., Lake Orion, MI 48360. [5/96]

HELICOPTER SCHOOL. Five days of hands-on instructions with X-Cell helicopters and Futaba and JR computer radios. Small classes, tailored to your individual needs, beginners to expert. Includes all meals and lodging. Over 420 students from 23 countries and 44 states, logging 14,500 flights in the last five years. Located on a 67-acre airport used exclusively for R/C training. Owned and operated by Ernie Huber, five-time National Helicopter Champion. Send for free information and class schedule now! P.O. Box 727, Crescent City, FL 32112; phone (800) 452-1677; fax (904) 698-4724. Outside U.S., phone (904) 698-4275. [6/96]

DETHERMALIZING CERTAINTY. For most free-flight models. Weighs .7 - 1.2 grams. large SASE to Wheels & Wings, P.O. Box 762, Lafayette, CA 94549-0762. [9/96]

TV SHOW. The producers at Telstar Video Productions, Inc., are proud to present the nation's only weekly half-hour TV show dedicated to model aviation. "REMOTE CONTROL" television can be seen on Satellite Galaxy 4, channel 15 or on cable: The Outdoor Channel. Call (800) 972-4847, or fax (407) 220-4849 for affiliate list or more information. Note to manufacturers: 30- or 60-second commercial spots are available. Advertise your products on national TV to millions of potential customers! [6/96]

PLANS TO BUILD—more than 700 tools, machines and accessories for your shop. Catalogue—$1. Wood-Met, Dept. MAN, 3314 W. Shoff Cir., Peoria, IL 61604-5964. [9/96]

FOR RELIABLE POWER system setups, send your O/S 91 engine, Dynamax fan and pipe. We will assemble, adjust and test fly. $60 labor. Bob Fiorenze (407) 330-1448. [7/96]

MIXERS & RETRACT CONTROLLERS! MicroMixer for flaperons, elevons, V-tails, flying wings! MicroRetracts sequences 3 servos in slow motion from one channel! These are tiny ⅓-ounce airborne computer controllers for standard radios! Without connectors, $29 each plus $2.25 shipping. Quillen Engineering, 561 N. 750 W., Hobart, IN 46342 (219) 759-5298. [7/96]

LARGE-SCALE SAILPLANES AND TOWPLANES—new and used—call (212) 879-1634, Sailplanes Unlimited, 63 East 82nd St., New York, NY 10028. [5/96]

R/C SKYDIVING: New Ram-air parachute now available. Illustrated catalog $1. R/C SKYDIVERS, Box 662L, St. Croix Falls, WI 54024. [6/96]

PLANS—Flying Flea (full size) plans: HM14 $45, HM16 $125. Archive, Box 892, Wooster, OH 44691. [6/96]

PLANS—R/C sailplanes, scale, sport and electric. Old-timer nostalgia and FF scale and sport-powered, rubber and towline. All models illustrated. Catalogue $2. Cirrus Aviation, P.O. Box 7093, Depot 4, Victoria, BC V9B 4Z2 Canada. [6/96]

R/C FLIGHT TRAINING. Your training is fun and easy in far western North Carolina near Murphy on your map. Write or call: R/C Flight Training, 120 Setawig Rd., Brasstown, NC 28902. (704) 389-8968. [6/96]

SOUTHWEST HOBBY SUPPLY: The nation's newest hobby supplier. Thousands of R/C & hobby products at the lowest possible prices. Send for your FREE 1996 catalogue today! P.O. Box 7021, Champaign, IL 61826-7021. [6/96]

BUILDING SERVICE. Trainers to jets! We build them. You fly them. We are at the leading edge of R/C aircraft assembly. (407) fly-jets; (407) 359-5387. We specialize in trainers, sport, scale, giant scale & jets. www.iag.net/~aircraft, or e-mail aircraft@iag.net. [6/96]

FOUR SCALE CATALOGUES. SPPS 171 superscale plans; SPPS 130,000 documentation photos, three-views; Nexus scale plans handbook; Nexus scale drawings; $5 each, Canada & USA. Add $5 each air overseas. Pepino's Scale Plans and Photo Service, 3209 Madison Ave., Greensboro, NC 27403; (910) 292-5239; Visa, Mastercard. [5/96]

PLANS—1/3, smaller, used by full-scale builders (Gee Bee's, etc.). See 2-96 SR/CM. Catalogue/News $4. Vern Clements, 308 Palo Alto, Caldwell, ID 83605. [7/96]

MACHINIST, FABRICATION, *models*, prototypes. Do you have a worn or broken part? Do you need a special part fabricated? Call us, we can make the piece for a reasonable price. Metal, plastic, springs, etc., you *name it. Pacific Coast Prototype, (916)* 472-3091. [5/96]

GIANT-SCALE SEAPLANE PLANS: 120-inch Grumman Widgeon, 109-inch Heinkel 115. Two stamps for information sheets on sixteen others. Sea-Clusion Aeronautics, Gene Falada, 22W070 Byron, Addison, IL *60101.* [5/96]

VINYL LETTERS AND GRAPHICS precisely cut to your specifications and prespaced for easy application,professional *results. Free catalogue. Compu-U-Cut, 976* W. Foothill Blvd., Suite 328, Claremont, CA 91711; (909) 624-2906. E-mail to: ddmc@cyberg8t.com. [7/96]

HISTORIC REPLICAS, DISCOUNTS, SUPERIOR PRODUCTS GUARANTEED! Official military issue A-2's, G-1's. Authentic cosmonaut watch. Luftwaffe, USAAF, Eagle Squadron bullion patches, Flying Tigers, Lafayette Escadrille accessories; wings, patches, shirts, medals, beer steins, scarf, pins from $4.95. Free gift with order. Catalogue $2, refundable. Company of Eagles, 875A Island Dr., Ste. 322N, Alameda, CA 94502. [7/96]

FIBERGLASS FLOATS-semi-scale round *top Edo. 6 sizes—29" to 48". Send* $2 for complete list of products to: Commander R/C Models, P.O. Box 821, Ft. Langley, B.C., Canada; V1M 2S2. Phone (604) 857-5494. [7/96]

SELL US YOUR RADIO-CONTROL VIDEOS! We will buy videotapes of R/C planes, cars, boats, etc. For more info, write to: Video Control, P.O. Box 7352, Dept 850, *Jacksonville, FL 32238.* [6/96]

GIANT-SCALE KITS: From Jim Meister Plans. Fun Scale P-51 and Spitfire. Squint Scale 81 inches, P-40B from Tim Farrell Flight Plans. *Custom cutting also available.* Send SASE to Starlight Hobbies, 3503 Main Street, Stone Ridge, NY 12484, or call (914) 687-4737 between 6-10p.m. [6/96]

HOBBYIST

PAYING $125 EACH for following toy metal outboard boat motors: Black Mercury MK-1000, Oliver, Seafury Twin, Gale Soverign. Also buying others. Gronowski, 140 N. Garfield Ave. Traverse City, MI 49686; (616) 941-2111. [5/96]

WANTED: Model engines and racecars before 1950. Don Blackburn, P.O. Box 15143, Amarillo, *TX 79105; (806)* 622-1657. [10/96]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $3 for *huge list to Rob Eierman,* 504 Las Posas, Ridgecrest, CA 93555; *(619) 375-5537.* [5/96]

MAGAZINE BACK ISSUES—*American Modeler, American Aircraft Modeler, Aeromodeller, Model Airplane News, Model Aircraft, RCM* and more; 1930s–1990s. For list, send SASE to Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [9/96]

WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc; Woody Bartelt, 3706 North 33rd, Galesburg, MI 49053; (616) 665-9693, or (800) 982-5464. [10/96]

CASH FOR ENGINES: ignition, glow, *diesel–all types;* any condition; sale list, too! Estates my specialty! Send SASE for list. Bob Boumstein, 10970 Marcy Plaza, Omaha, NE 68154; (402) 334-0122. [5/96]

WANTED: *Old, unbuilt,* plastic model kits from '50s and '60s. Send list, price to Models, Box 863, Wyandette, MI 48192. [2/97]

ENGINES, KITS & ACCESSORIES: 35-year collection for sale. For listing send #10 SSAE to: Ed Hagerlin, Box 1980, Overton, NV 89040. [8/96]

MODEL AIRPLANE NEWS, 1930-1980; "Air Trails," 1935-1952; "Young Men," 1952-1956; "American Modeler," 1957-1967; "American Aircraft Modeler," 1968-1975. $1 for list. George Reith, 3597 Arbutus Dr. N., Cobble Hill, B.C. Canada V0R 1L1. [8/96]

COLLECTION FOR SALE: Over 350 kits from 40's, 50's, 60's, F/F, R/C, U/C, Rubber, Solids, Jetex. Send SASE ($.55) to Dr. Frank Iacobellis, 62 Palisade Rd., Rye, *NY 10580,* or call (914) 967-5550. [8/96]

MODEL MOTORS WANTED: most types, *1970 and earlier.* Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [6/96]

WANTED: Cox, Wen-Mac, Testors, etc. *Gas-powered plastic cars, planes, boats.* Please call or write. Dean Barham, 4032 Iowa St., San Diego, CA 92104; (619) 528-1680. [7/96]

SLOT CARS WANTED: Cox, Aurora, Tyco, etc. 1960's, 1970's vintage; any scale. Please call or write. Dean Barham, 4032 Iowa St., San *Diego, CA 92104;* (619) 528-1680. [7/96]

P-38 LIGHTNING—LOVE IT? Join a group of P-38 modeling and full-size enthusiasts. Share modeling, flying, historic *facts and articles about the P-38. Entering* fee of $15 covers newsletters and club patch. For more information, write: P-38 M.O.I. Ron Parker, 3003 Windchase, #1003, Houston, TX 77082-3444. [10/96]

WANTED: Model engines and racecars before 1956. Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [12/96]

WANTED: Built or partially built scale Cessna 150, 152, or 172. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; phone (714) 768-0585; fax (714) 458-6455. [12/96]

CARS. Selling model collection, 1973 *issues up, ½4-½5, individual prices, about* 800. Ralph, Box 2423-P, Yakima, WA (509) 965-0670. [6/96]

FOR SALE: Citabria 108-inch span, red *fabric, G-38 engine with 7-channel NB* radio—$675. (541) 382-1498. [6/96]

P-38 LIGHTNING, COLUMBIA MODEL WORKS KIT—95-inch wingspan, Super *Tiger 2500's, Robart retracts, Futaba radio,* everything new, never been flown—$2,300. LaSalle, IL (815) 223-6782. [6/96]

GIANT SCALE: WW II, OQ-3 Target Drone, 12-foot span. Original fuselage, wings, replica tail. Documentation, misc. parts. No engine. $1,050 invested. Best offer. (717) *743-6401.* 5 - 6 p.m. [6/96]

EZ PILOT ARFS WANTED: (512) 918-0147. [8/96]

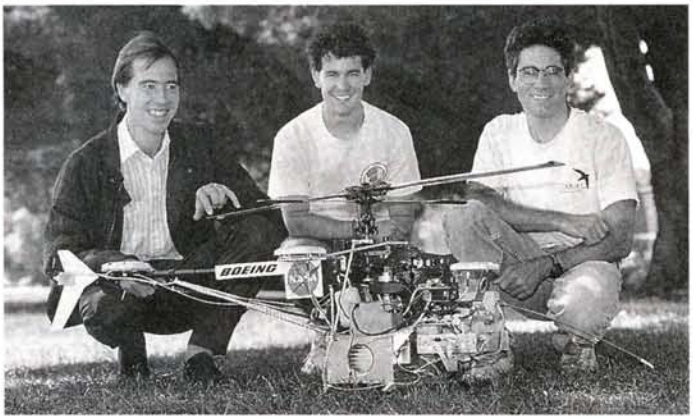
FOR SALE: Jim Walker Fireball original parts. Fuselage, wings, etc. $50 takes all. SSAE for list. Bernard Mallon, 27 Hillside Ave., Warwick, NY 10990. [5/96]

EVENTS

CORONA, CA—MAIN EVENT SHOW, *2180 Nevada. May 24, 25, 26. Friday 5pm* - 10pm, Saturday, Sunday, 10a.m. to 5p.m. Free admission. (909) 371-4451. [5/96]

RATES: non-commercial—25 cents per word (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.** To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. Please make all checks payable to: **AIR AGE, INC. SEND AD AND PAYMENT TO: Elise Silkowski, CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035, or call (203) 834-2339.**

FLYING BY SATELLITE



Left to right: Andrew Conway, Bruce Woodley and Stephen Morris. These R/C'ers perfected the system that stabilized an R/C helicopter based on GPS information broadcast by satellite.

Many will recall the Oblique Flying Wing—one of Steve Morris's advanced R/C projects—covered on this page in our August '95 issue. Well, Steve and his buddies have been at it again! This time, they have created an R/C helicopter that is stabilized entirely by GPS satellite information—no gyros or accelerometers, just GPS sensors and an onboard 486 computer to keep the heli stabilized in flight.

The story begins at Stanford University in 1993 when Andrew Conway, a Ph.D. student in electrical engineering, approached Steve (who had received a Ph.D. in aeronautics from Stanford in '90, and who retained the title of research associate at Stanford) to see if he would be interested in building an autonomous flying vehicle for the Aerial Robotics Competition held annually at Georgia Tech. It would use an advanced GPS system developed at Stanford. Steve jumped on it, and Boeing and NASA donated money to purchase the equipment. A two-year project to develop the system ensued, during which Andrew completed his Ph.D. (his second, after one in mathematics from Sydney University in Australia). In late May 1995, Steve and Andrew were joined by electrical engineering Ph.D. student Bruce Woodley, and the three worked nonstop for two months to program the helicopter to meet contest requirements.

The contest-winning machine is a modified X-Cell Pro helicopter that weighed 23 pounds ready to fly. The O.S. 61-SXH engine was modified by switching to an aluminum-aluminum-chrome cylinder liner from Performance Specialties Products and a Hatori tuned muffler. Fuel was Cool Power 30-percent nitro. The box at the lower front of the machine is a 486 computer. The light-colored objects mounted on the upper surfaces of the tail, nose and sides are GPS antennae.

The '95 contest required that an autonomous flying machine travel to a 6-foot-diameter ring marked on the ground, pick up six, small, 4-inch metal disks, and fly them to a separate 6-foot ring, one disk at a time.

In '95, the contest was the fiercest ever. The University of Texas at Arlington team was able to take off, land and hover autonomously with a tail-sitter design, which helped them take third place. The Technical University of Berlin team brought a sonar-guided blimp that looked quite competitive, and its ability to fly autonomously and search for a disk earned it second place.

The Stanford team felt their entry had to at least pick up and relocate a disk to win. Their simple magnetic disk retriever, coupled with a random-search strategy, wound up picking up two disks at a time. After adjusting the suspended length of the retriever, the team's entry was able to pick up a single disk and move it over the other ring on its own—the first time this had been done at any of the contests. The team took first place and $7,000 in prize winnings. Because the Stanford entry had essentially solved the primary tasks posed by the contest, the rules of future competitions are being amended to require a visual recognition system and more complex tasks.

The winning helicopter—a modified X-Cell Pro with an O.S. 61-SXH engine—weighed 23 pounds. It flew with excellent stability and, when set to hover, it easily maintained a position within a 1-meter box, even in mildly windy conditions. Some minor vertical oscillations were noted. Although the helicopter could fly out of ground effect (many contest entries haven't been able to), it could descend more readily than ascend, causing the oscillation.

The key to stability was a ground station that communicated with the helicopter. The ground station corrected for data corruption intentionally included in the GPS signal and for atmospheric conditions, and then it relayed the corrections to the helicopter in real time. The heli has four GPS antennae on it that are used to compute the tilt angles and location of the machine. The system included rewritten software that "calculated the integer number of wavelengths and the present phase of the carrier signal to the helicopter antenna" so that the actual position of the helicopter was known within 1 centimeter, relative to the ground station. That's better than current military systems.

Steve Morris is currently working as a research engineer at Lockheed Martin. We'll keep you posted on his high-tech R/C projects. If you're interested in the July 15, 1996, robotics competition (sponsored by the association of Unmanned Vehicle Systems) at the Epcot center in Florida, contact professor Rob Michelson at Georgia Tech, in Atlanta, GA; (770) 528-7568. *—Tom Atwood*